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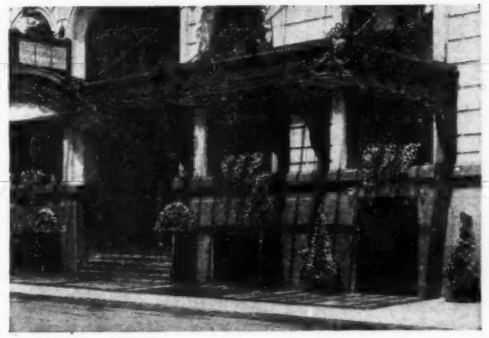

FLORAL DECORATION OF CIVIC BUILDINGS AS A CONTRIBUTION TO CIVIC BEAUTY.

The real price of everything, what everything really costs to the man who wants to acquire it, is the toil and trouble of acquiring it. What everything is really worth to the man who has acquired it and who wants to dispose of it or exchange it for something else, is the toil and trouble which it can save to himself and which it can impose upon other people.—ADAM SMITH.

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BITULITHIC *on* MACADAM

ON MARLBORO STREET, BOSTON, MASS.

The economical resurfacing of old macadam streets on which traffic has increased until a better wearing surface is demanded is a problem which troubles many cities. The successful solution of the problem on several streets in Boston, Mass., warrants a description of the method used. The specifications are given almost in full because they show how to meet one of the difficulties, that of keeping the cost as low as it should be, by the simple expedient of paying for all labor directly. The method of separating the other items and leaving them open to competition in the bidding is ingenious and should result in the lowest possible cost of the completed work. The photographs show the various steps in the work and need no further explanation.

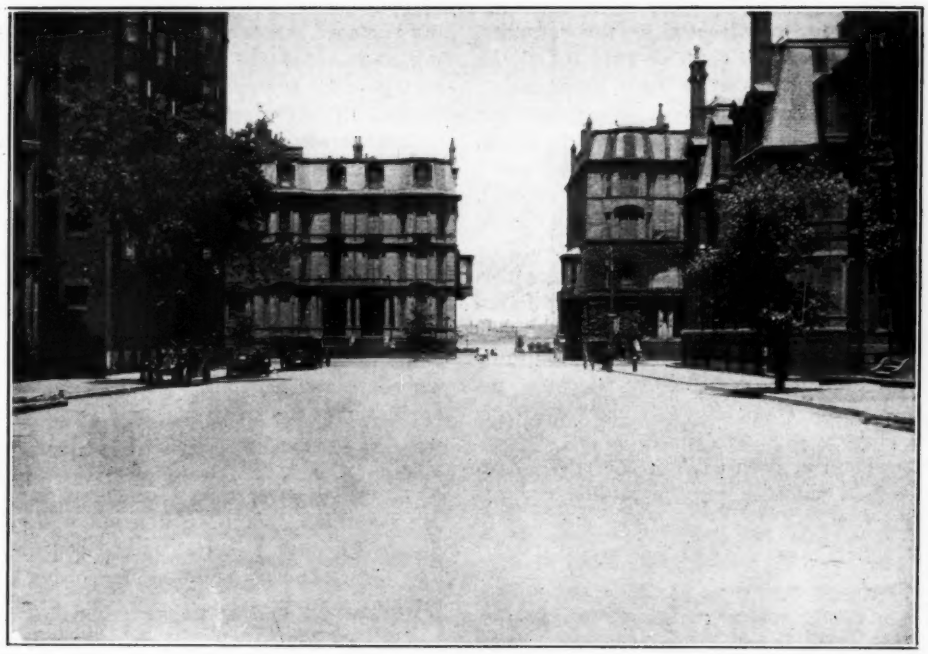
IN the year 1903, bitulithic surface on a crushed stone macadam foundation, was laid on Dartmouth street from Newbury street to Beacon street, in the fashionable residential Back Bay district of Boston.

The Dartmouth street pavement, now eleven years old, has proved so satisfactory that the taxpayers of Marlboro street, which intersects Dartmouth, have, for several years, urgently petitioned for the laying of bitulithic on Marlboro street, from Clarendon street to Massachusetts avenue. In the meantime the city has been attempting to keep the macadam on Marlboro street in repair by the frequent addition of new stone and surface applications of various forms of bituminous material, all of which have proved to provide periodically a dusty, muddy, oily and generally quite unsatisfactory wearing surface. During the spring of the present year Mayor Curley directed that the petition of the property owners, requesting a new pavement, be complied with, and Commissioner Rourke awarded the contract May 25 to Jas. Doherty for surfacing the macadam with bitulithic at a cost of $1.645 per square yard, including 5-year guaranty.

The bitulithic surface mixture is being made by Warren Brothers Company, at its permanent plant in East Cambridge, about two miles from the site of the work on Marlboro street. The contract price of bitulithic surface is $1.48 plus 16½ cents per square yard for scarifying and regulating the grade of the old macadam. This price does not include the hauling away of granite crosswalks, granite paving block gutters and other surplus materials, nor the furnishing of new stone to take the place of the gutter paving and crosswalks. It is estimated that the old granite gutter blocks and crosswalks, removed by the city, are worth about 15 cents per square yard of entire area of the street, so that the net cost of the improvement complete is about $1.50 per square yard.

Owing to the fact that crushed stone has been periodically rolled into the surface for about twenty years, the crown has become undesirably high, necessitating regulation of the surface and reshaping the crown by picking off the surplus macadam at the crown and placing it in the gutter and depressions in the surface of the old macadam. After this regulation of grade the macadam is rerolled and the standard crown of ¼-inch per foot of width and uniform grade thus established. All labor in connection with the regulation and rolling of the grade, but as noted above no new material in foundation, is including in the gross cost of $1.645 per square yard.

If the crown of the old macadam had



DARTMOUTH STREET, *Boston, Mass., June* 15, 1914, *from Marlboro street, looking toward Beacon street. Bitulithic surface, laid on old macadam foundation in* 1903.

not been raised by many years' accumulation of repairs the picking of the surface would have been unnecessary, except as to the few high spots which are always found to a greater or less extent on old macadam surface. It is most economical and desirable to build on the old macadam without disturbing it. During the years 1912 and 1913 Warrenite road was laid in Connecticut, under contract with the state highway department, to the extent of 55.9 miles of roadway, 16 feet wide, most of which was laid over the old macadam without disturbing it.

Warren Brothers Company's latest specifications include the following provisions applicable particularly to this class of construction:

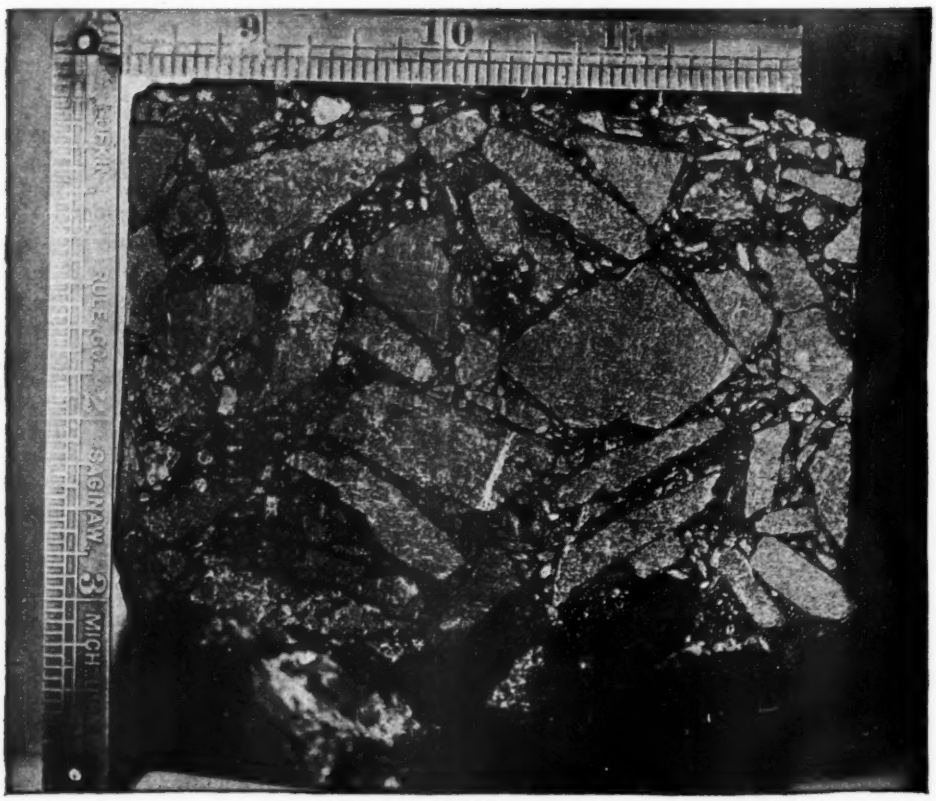
"It is the general intention of this specification that the different parts of the existing macadam roadbed shall be given such treatment as will most economically give the desired results and any or all of the methods of treatment given below, or a combination of them, may be adopted at the discretion of the engineer for different portions of the work.

"1. Where the existing surface of the macadam is generally of suitable grade and contour, the surface of the existing macadam shall be swept for the width to be surfaced so as to dislodge and remove the detritus and expose the stone. The ruts and depressions existing shall be filled with bituminous binder which shall be compacted by tamping and rolling, so that the finished sub-grade shall be parallel to and substantially 2 inches below the proposed finished surface of the road. Bituminous binder shall be made as herein specified and shall be paid for at the price bid per ton of 2,000 pounds delivered on the site of the work. The cost of spreading, tamping and rolling the binder shall be paid for at the actual cost of labor plus 15 per cent. At the edges of the bitulithic surface, 2 by 4-inch joists shall be laid and spiked in position on the roadbed to provide a shoulder against which the bitulithic surface shall be laid, and after the surface is laid and rolled, the spikes and joists shall be removed and stone or gravel shall be spread over the shoulders to such depth and in such man-

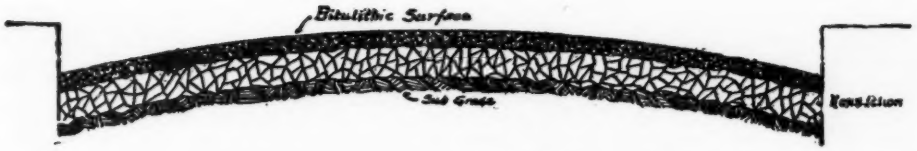
ner as may be directed by the engineer. Stone and gravel shall be paid for at the price per cubic yard bid for these materials. The cost of labor in spreading stone and gravel, and of all spikes and joists, and the labor expended in placing same shall be paid for at cost plus 15 per cent.

"2. Where the contour of the existing macadam is such as to provide too flat a crown for the finished surface, the portions of macadam at the edges of the area to be resurfaced may be removed by picks or otherwise so as to provide a suitable contour and in cases where the new surface does not extend to a curb stone or header a shoulder shall be left in the macadam at each edge of the travel path against which to lay the bitulithic wearing surface. All labor required in removing such macadam shall be paid for at cost plus 15 per cent. Where the condition of the existing macadam surface is such as to require a general redistribution of the material in the roadbed, the roadbed shall be scarified and the material redistributed over the roadbed and thoroly rolled to the desired grade and contour. Where required by the engineer, loose stone or gravel shall be provided by the contractor. Such stone or gravel shall be paid for at the price per cubic yard bid for same and the labor required for the spreading of the stone or gravel and scarifying of the roadbed shall paid for at cost plus 15 per cent.

"3. Any soft springy places unsuitable for resurfacing shall be dug out and refilled with such material as the engineer may direct, thoroly solidified by rolling or tamping and brought to proper grade. Crushed stone, gravel, bituminous binder or Portland cement concrete which may



CROSS-SECTION *of bitulithic pavement on Dartmouth street, Boston, Mass., laid in* 1903. *Sample taken from cut for sewer in* 1911, *after eight years of use.*



CROSS-SECTION *of corrected old macadam foundation and new bitulithic wearing surface, showing the condition to be approximated by the new construction.*

be ordered used by the engineer will be paid for at the price bid for such materials and the labor required for preparing the sub-grade and the placing of all materials in place, shall be paid for at cost plus 15 per cent.

"Bituminous binder shall consist of sound gravel or crushed stone which will pass through a screen having openings 1 inch in diameter and will pass over a screen having openings ¼-inch in diameter, and, shall contain about 10 per cent. of sand screenings passing screen openings ¼-inch in diameter. The gravel or crushed stone shall be heated to a temperature of about 225 deg. F. and mixed with sufficient bituminous cement to thoroughly coat all the particles, after which it shall be hauled to the road and spread while hot over the roadbed as may be directed by the engineer. Bituminous binder delivered on the site of the work shall be paid for at the price per ton stipulated in the bid. The placing of the bituminous binder on the roadbed and the tamping and rolling of the same shall be paid for at actual cost of the labor plus 15 per cent.

"Crushed stone for the preparation of the roadbed and shoulders, where ordered by the engineer, shall be of hard sound stone of such size or sizes as may be required by the engineer. Crushed stone shall be paid for and delivered on the site of the work at the price per cubic yard stipulated in the bid. The labor used for the placing of the crushed stone in position as directed by the engineer shall be paid for at cost plus 15 per cent.

"Gravel shall be used as directed by the engineer in the preparation of the subgrade and shoulders. The gravel shall contain not more than 25 per cent. of material finer than ¼-inch and shall all pass a screen having 2-inch square openings and shall be acceptable to the engineer. Gravel, where ordered, shall be paid for delivered on the site of the work at the price bid per cubic yard. The labor used in placing the gravel as directed shall be paid for at cost plus 15 per cent.

"Where ordered by the engineer, portland cement concrete shall be laid to such depth as he may direct, and paid for delivered in place on the work at the price bid per cubic yard.

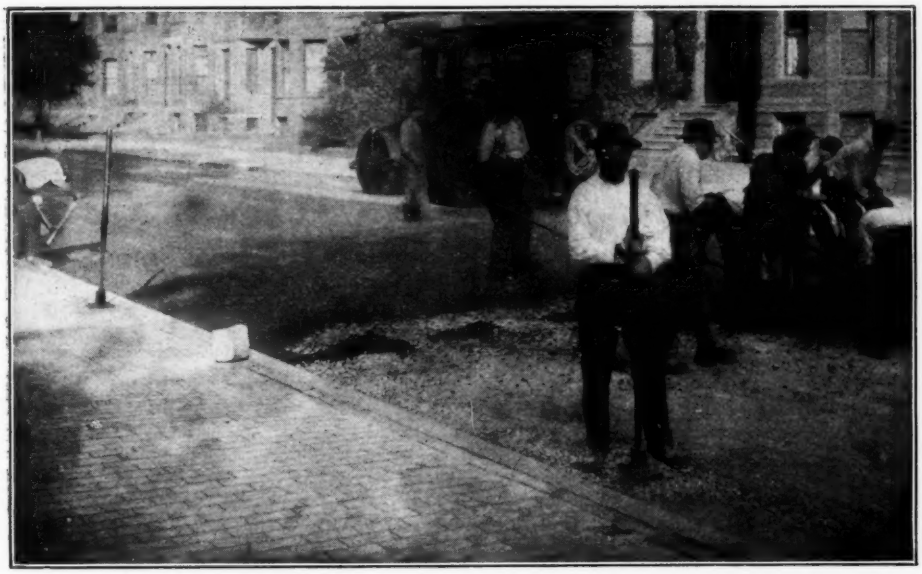
"On the foundation prepared as hereinabove specified shall be laid the following wearing surface composed of hard crushed stone, sand, and bituminous cement to have the thickness when compressed of 2 inches.

"The following method and apparatus shall be used in the preparation of the wearing surface. The stone and sand shall be heated in a rotary drier and while still hot, separated into the desired number of different sizes by means of a rotary screen having a minimum screen opening of 1-10 of an inch and a maximum opening of about 1½-inch. The openings in the successive screen sections up to ½-inch size shall not vary more than ¼-inch and not more than ¾-inch for the sizes larger than ½-inch. The aggregate thus separated shall pass into a bin having sections or compartments corresponding to the screen sections. From these compartments the aggregate shall pass into a weigh box, resting on a multi-beam scale. The desired amount of aggregate from each of the above compartments shall be accurately weighed separately on the scale and the batch dropped into a "twin pug" mixer where it shall be intimately associated and thoroly commingled with a predetermined quantity of bitulithic cement sufficient to coat all particles of the aggregate and to fill the voids in same. The different grades of stone

MARLBORO STREET, *Boston, Mass. Picking surface of old macadam to reduce crown preparatory to laying new bitulithic surface.*

and sand ranging in size from impalpable powder to about one-half the thickness of the wearing surface shall be combined in such proportions as to secure, in the mineral aggregate, inherent stability, that it, density or low percentage of voids, and stability or resistance to displacement, producing an aggregate which, when combined with the bitulithic cement and laid in place and compacted, will form a street paving structure consisting of mineral ag-

MARLBORO STREET, *Boston, Mass. Rolling the regulated old macadam roadway preparatory to laying bitulithic wearing surface.*



MARLBORO STREET, *Boston, Mass. Laying bitulithic surface over old macadam, after regulating the grade.*

gregate of different sizes and the bitulithic cement which permeates the entire mass fills the voids and unites the various particles thereof. If the crushed stone and sand do not contain enough finely divided particles or impalpable powder to produce a low percentage of voids in the aggregate the deficiency shall be made up by the addition of any other suitable fine mineral matter.

"The mixture and ingredients thereof shall be maintained at a temperature consistent with good workmanship. The mixture when reaching the street shall be hot enough to allow of being spread and raked and shall not be so hot as to injure the bitulithic cement.

There shall be spread over the bitulithic surface mixture a seal coat, using per square yard of bitulithic pavement approximately ¼-gallon of bitulithic cement, into which shall be incorporated approximately 25 pounds of mineral aggregate not larger than ¼-inch diameter. After spreading the seal coat, it shall be thoroly rolled into the bitulithic surface mixture.

"Each layer of the work shall be kept as free as possible from dirt, so that it will unite with the succeeding layer.

"The bituminous composition or cement shall in each case be free from water, and shall be especially refined to remove volatile and other matter susceptible to atmospheric influences.

"Warren Brothers Company, owner of the patents used in the construction of the bitulithic pavement, shall file with the proper official or board which is about to receive bids for the work, a properly executed binding agreement to furnish to any contractor desiring to bid for the work all the necessary bitulithic surface material, mixed ready for use, and bitulithic cement, and the sand, gravel, or stone screenings for the surface finish course, in accordance with sections, 'Wearing Surface' and 'Surface Finish', at a definite reasonable price per square yard. Said price shall include a license to use all of the patents required in the construction of the bitulithic pavement as herein specified.

"Bitulithic wearing surface and surface finish laid in place shall be paid for at the price bid per square yard."

The specifications are copyrighted, but cna be used by city and other engineers and municipal officials, provided they are not modified, as to wearing surface and surface finish, without permission.

MARLBORO STREET, *Boston, Mass. Spreading flush coat of bitumen and stone chips over bitulithic surface.*

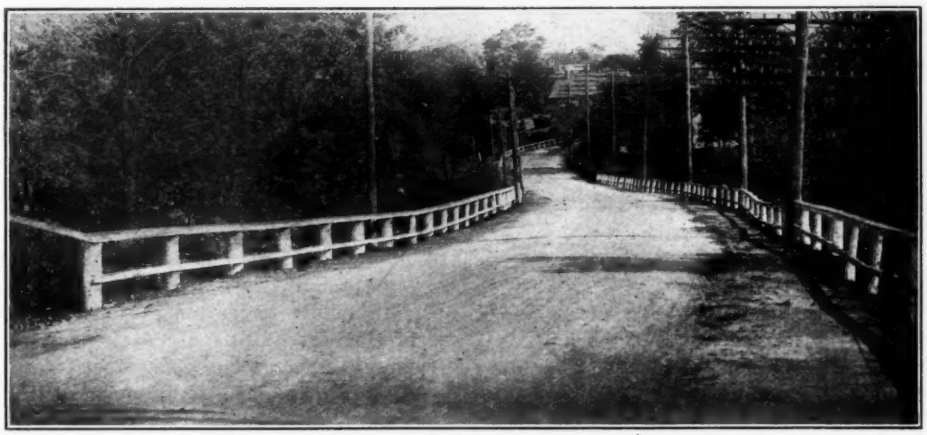
Necessarily, the cost of regulation of grade of the old macadam varies very widely, depending on the grade and condition of the old macadam and might vary as much as from 5 cents to 25 cents per square yard, depending on the quantity of new material required. On account of the varying conditions of the old macadam and consequently varying treatment, fairness to both contractors and city necessitates the establishment of unit prices for material and "force account" for the labor required in connection with the regulation of the grade of the old macadam. In fact, it is practically impossible for the engineer definitely to determine in advance of the letting of a contract, or until the work is in actual progress, exactly how much of each class

MARLBORO STREET, *Boston, Mass. Finished bitulithic surface laid over old macadam, from Dartmouth street, looking toward Clarendon street, on June 15, 1914, just completed.*

of new material will be required or how to treat most economically each part of the surface. If, therefore, the specifications provide that this preparatory work is to be done at a price bid per square yard the contractor must bid high enough to be safe and probably 50 to 100 per cent. more than the work would cost under fair unit prices for each class of material used and "force account" for the labor employed in preparation of the foundation. On the 55.9 miles of work in Connecticut on this basis the cost of preparation of the old macadam for the new surface averaged 11½ cents per square yard.

The accompanying photographs give a clear idea of the Marlboro street, Boston, construction above described.

BOSTON POST ROAD, *Greenwich, Conn., looking east, showing Warrenite surface laid on old macadam foundation.*



JERSEY CITY PORT DEVELOPMENT

Bion J. Arnold has been retained as consulting engineer and F. V. Lane as resident engineer, by the Jersey City, N. J., Chamber of Commerce, to make a study of methods of improving the transfer and transportation facilities of that port.

Primarily this work will be the development of the port facilities, which means that Mr. Arnold will be obliged to study the improvement of waterways, location and construction of docks and dock equipment for handling cargoes. A connecting railroad is an integral part of port development, so that all the railroads which terminate in Hudson County could be advantageously connected with each other and with all the docks which may be built on the waterfront and extending spurs to every part of the thousands of acres of low lands which are so exceptionally suitable for factory sites. Terminal yards and buildings and classification yards must be studied. Street locations and trolley lines enter into the problem of port development and must be given attention in any careful plan.

This development must be worked out with the city commissioner, county freeholders, the authorities of neighboring municipalities, with the New Jersey Harbor Commission and the New York Harbor Line Board of the U. S. Army, all of which must directly participate in financing improvements, or in constructing them, or in approving plans. Besides the governmental agencies involved, there are the railroads and steamship lines, the shippers and private owners of property, all of whose interests must be given due regard.

CITY GOVERNMENT IN NEW ZEALAND

By W. D. Hornaday, Austin, Texas.

The author is an experienced observer who has just returned from a trip thru New Zealand and gives an unprejudiced view of the marvelous progress made in this wonderland of the South Seas in the eighty years since the first white man was able to retain a foothold on its soil. He makes some statements which whet the interest in the results of some of the advanced experiments in municipal government which are in progress.

ONE of the most striking features of town government in New Zealand is the apparent cumbersomeness of the system, particularly as applied to the larger population centers. On the whole, however, the public affairs of the different municipalities have the appearance of being splendidly administered. There are ample evidences of the exercise of well directed civic pride. Just as the Dominion government of New Zealand has gone in extensively for nationalization of different public service systems and industries, so have the cities and towns adopted the policy of municipal ownership of practically all public utility plants and have assumed control of many other things that are supposed to contribute to the comfort and enjoyment of their inhabitants.

One of the remarkable features of New Zealand municipalities is the great number of boros that go to make up the four large population centers—Auckland, Wellington, Christchurch and Dunedin. Take Auckland as an illustration. The city itself has a population of only about 45,000 people, but closely adjoining it are the towns or boros of Birkhead, Davenport, Grey, Lynn, Mount Albert, Mount Eden, Newmarket, Northcote and Parnell, which, combined, bring up the population of what is commonly known as Auckland to about 110,000. The different boros fit closely and snugly together, making so far as appearances go, one solid city. Each of these different boros has its own municipal government, and usually owns its own public utility plants. It is a cumbersome and expensive municipal system that was brought over from England.

While the cities and their adjacent boros ordinarily work together harmoniously in public improvements and other matters that require more or less co-operation, it is apparent that much more could be accomplished for the good of the citizens of the respective municipalities if there were no intervening boundary lines. On the other hand, the supporters of the boro system of population centers claim that the rivalry of the different suburban towns has a stimulating effect on their growth and business development. This argument may be correct, but one of the things that New Zealand is suffering from at this time is an over-concentration of her population in cities and towns. It would be for the good of the Dominion if the municipalities were of slower growth.

Each city and boro fixes its own tax rate and this varies considerably in the different corporations. Some of the municipal entities have adopted the system of levying taxes on unimproved values, but this principle has not been adopted as generally as I had been led to believe before making an investigation on this account. It is optional with each municipality as to whether this single tax provision shall be placed in effect. In 1896 an act was passed by Parliament authorizing local bodies to adopt the unim-

TOWN HALL *at Wellington, New Zealand, a city of about sixty-six thousand population.*

proved valuation principle as to land. It provides in this law that a return to the old system of taxation can be made, if desired, after three years' trial of the new one. The method of determining whether the taxes shall be levied on unimproved value of land is by submitting the proposition to a referendum vote upon a petition of 25 per cent. of the tax payers where the total number in a boro or district does not exceed one hundred, and of 15 per cent. where the number exceeds three hundred. The proposition is decided by a majority of the votes cast. It is also provided that a rescinding proposal can be adopted by the same means as the one for putting it into effect, but not until after three years have elapsed. Once a proposal is rejected, it cannot again by submitted to the taxpayers until another three years are past.

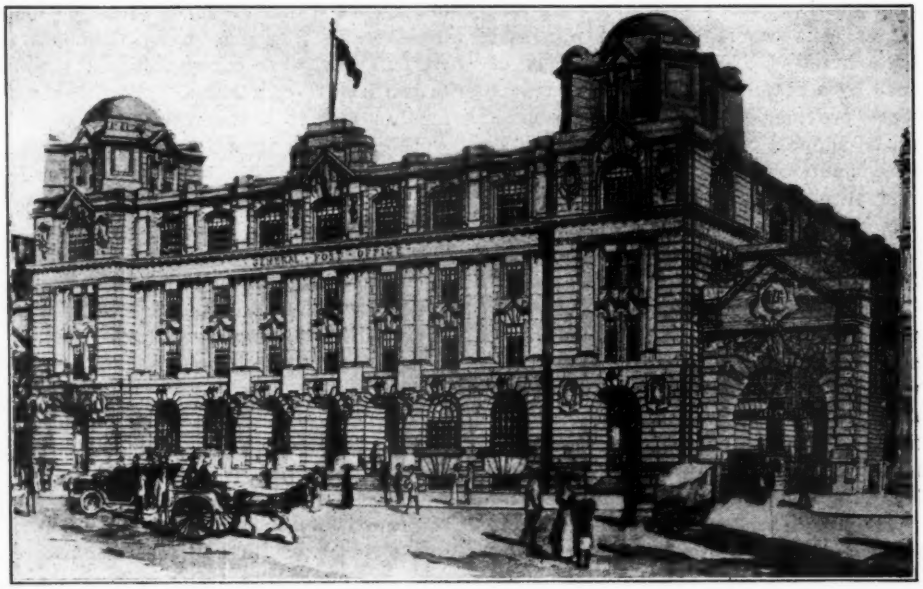
The system of taxing the unimproved value of land is in effect in Wellington and Christchurch, but the proposition was rejected by the taxpayers of Auckland and a number of other smaller municipalities. In Wellington and several of the boros, where the vacant lots are taxed on the unimproved value, the system has not given entire satisfaction. The chief complaint against it is that it has caused a too close settlement and has done away with many breathing spots around the homes in Wellington, particularly in the sections of the city where land values are high. Many of the home owners can hardly afford to retain an unoccupied lot. This has caused dwellings to be jammed close together and has done away with flower gardens and other surroundings that add to the beauty of a home. The difference in this respect between Wellington and Auckland is apparent even to the most casual visitor. In the latter city there are well-kept lawns and flower-embowered spaces adjoining many of the residences. It is not apparent, either, that the system of taxing the unimproved value has stimulated the building up of the business districts of the towns where it is in effect.

The general municipal tax rate authorized by law is 50 cents in $5 on the annual or 3 cents in $5 on the capital value of all taxable property or its equivalent on unimproved value.

Where boros are divided into wards, the rate levied may vary in the different wards, but must in any case not exceed the legal limit. The system of taxation is

AUCKLAND, *New Zealand, is a city of about one hundred thousand population. The upper photograph shows the Town Hall and the lower shows the general postoffice.*

upon the basis that 25 cents in $5 on the annual value of the property, by which is meant its worth as assessed annually, is deemed to be equivalent to 1½ cents in $5 on capital value of any taxable property. The assessment of the unimproved value must be so adjusted as to equal as nearly as possible in producing capacity the limit of taxing power on the capital or annual value as the case may be. The annual



value is deemed to be the letting value less 20 per cent. in case of dwellings, buildings and other perishable property, and 10 per cent. of land, but in no case less than 5 per cent. of the value of the fee simple. The capital value is deemed to be the selling value of the land, including improvements at the time of the valuation, excluding the value of any existing improvements.

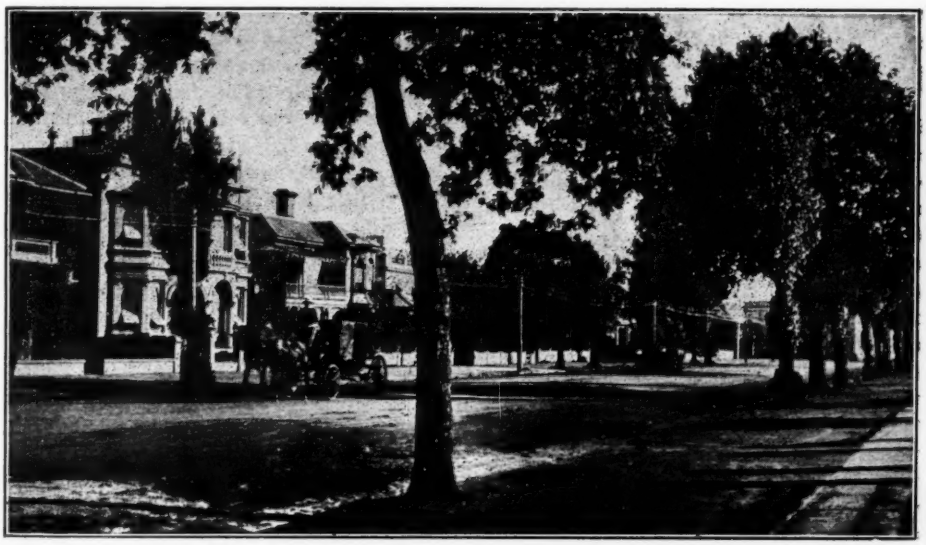
The functions of municipal councils in New Zealand are much the same as those of similar bodies in the United States. It would seem that not as much progress has been made in municipal government affairs here as has been accomplished in those relating to the Dominion itself. While different city and boro administrations are honest and well meaning, their officials are not given the latitude for accomplishing things for their people that one might expect to find.

The dividing of the larger population centers, such as Wellington, Auckland, Christchurch and Dunedin, into a number of suburbs or boros, each with its separate government organizations, makes conditions more or less complicated. Each town council shall consist of not less than six or more than twenty-one members, according to the population, who are elected every two years. The mayor, who presides over the council meetings, is elected annually. The councils have under their control the construction, maintenance and operation of all public improvements and public utilities.

Much attention is given to providing park and recreation grounds and giving the people an abundant supply of pure water. The streets of all the cities are well kept, many of them being paved and otherwise improved in a modern manner.

As an example of what a New Zealand municipality is doing, particularly in the way of operating its public service properties, Wellington may be cited. The assessed capital value of its property on March 31, 1913, was $95,807,125; unimproved value, $50,456,000; value of improvements, $45,351,125. These figures apply only to the city itself and do not include the adjacent suburbs, the population of the city being 66,138 and covering an area of 9,505 acres. Within this area were 17,372 buildings. The revenue for the fiscal years, 1912-13, from all sources, was $2,216,715. This sum was derived from taxes amounting to $768,360 and the balance being made up from payments made from rents, baths, town hall letting, licenses, organ recitals, orchestral concerts, abattoirs, water, libraries, cemetery,

RESIDENCE STREET *in Auckland, New Zealand. Note the ample space about the houses. Single tax is not in operation here.*



GRAFTON BRIDGE, *of reinforced concrete, at Auckland, New Zealand.*

crematorium, zoos, building fees, interest on deposits, fish market and other sources. The total amount of money expended by the city in the same year was $2,142,255. The total indebtedness of the city was $11,445,250. This is made up of a large number of loans, which bear interest at the rate of 4 to 4½ per cent. The total sinking fund on March 31, 1913, aggregated $1,307,814.

The Wellington corporation owns the electric street railway system, which was constructed at a cost, including the power plant, of $8,240,605. It also owns the electric lighting system and water works plant and distributing system. The electric tramways department of the city is headed by an electrical engineer, the other officials being a traffic superintendent, accountant, superintendent for public ways, power stations superintendent, light superintendent, overhead equipment superintendent, power sheds superintendent and two traffic inspectors. The board of management consists of the city engineer, who is chairman, the electrical engineer and the traffic superintendent. The lines have been laid in the main streets of Wellington and all the suburbs, extending to many of the pleasure resorts on the different bays and other places of interest. The total number of cars in operation is 87, consisting of eight different types, the capacity of each ranging from twenty-four to one hundred and three passengers. The power station was constructed at a cost of $551,000. The system consists of about seven miles of double track and thirty miles of single track. During the fiscal year 1912-13, 23,858,412 passengers were carried, which was an average of 11.8 passengers per car mile. The average fare per passenger was 2 4/5 cents. The total population served was 68,000. The average journey per head of population served during the year was 350 miles. The average traffic revenue per head of population served during the year was $11.07. The net surplus from the tramways for the year was $59,525, and from the power supply and public lighting $5,490.

The city owns its own abattoir, which has accommodations for slaughtering all live stock required for local consumption other than that which had already been provided for by the various local meat dealers. These companies are subject to government supervision.

The pretty custom of naming the residences instead of numbering them is in vogue in several cities and towns. In Auckland the adoption of Maori names for homes is quite general. Usually the name is painted on the fence in front of the property or is given a prominent place upon the door of the house itself.

The masses of New Zealand are lovers of outdoor pleasures, and in order to provide places for recreation the different municipalities maintain beautiful parks and playgrounds. As a further contribution to the enjoyment of the citizens, the city of Wellington has an official organist who gives public recitals in the auditorium of the town hall. Not long ago there was some objection raised by local citizens as to the character of music which the organist was giving the public. Some wanted classical while others thought ragtime or other popular airs would be more generally appreciated.

The fact that many of the larger cities and towns are situated near the ocean makes bathing and aquatic sports the chief advertisement for a large percentage of the population. On holidays and Sundays, crowds of people flock to the different resorts on the sea-shore.

PRINCESS STREET, *the business street of Dunedin, New Zealand.*

AUTOMOBILE STREET CLEANING MACHINES

One of the latest applications of the motor vehicle is to street cleaning and sprinkling. There are many forms of machines which have been developed, a few of which, gathered from various cities, are here described so that they can be compared and contrasted for the kinds of work to which they are adapted. The American machines compare most favorably with those from foreign cities.

STREET cleaning, including sprinkling, sweeping and flushing, is a field which is being rapidly taken by the motor, even under the conditions of the problem which prevent the full utilization of the greater speed of which the automobile is capable. Nevertheless, the quantity and quality of the work and the relative cost cause municipal officials to look favorably upon motor apparatus for these purposes.

The municipal officer considering the question requires information on two points. He can easily be assured of the superiority of the motor on the score of hygiene, but, naturally, the matter of cost is important. Figures which are most informative on this point are those, not of office estimates, but which have been recorded in actual service. Those based on the results obtained in different cities, in which the machines illustrated are used, may be of special interest.

A decade ago, the City of Paris placed in service one of the French motor sprinkling machines shown in one of the accompanying photographs, and this machine is still running and is greatly admired by the users for the ease with which it sprinkles the wide roads of the Bois de Boulogne.

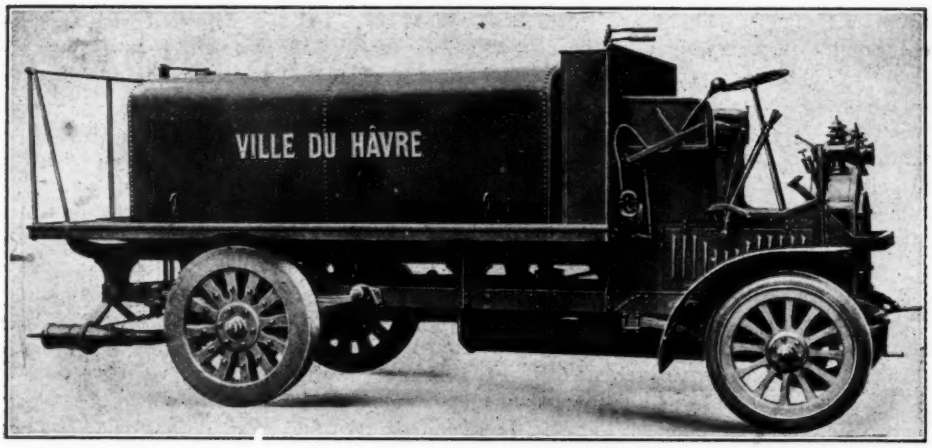
The cities of Versailles, Havre, Dijon, Deauville, Trouville, Monte Carlo, Santander, Buenos Aires and Mendoza, soon followed the example of Paris.

In sprinkling streets in Versailles, France, a tank of 660 gallons waters a surface of 13,156 square yards, say 20 square yards per gallon, and twenty-five charges are used in a ten-hour day, covering 328,900 square yards. An ordinary horse-drawn tank waters about 42,000 square yards in a ten-hour day and one motor waterer can replace six, seven or even eight horse-drawn sprinklers.

Now comparing the costs, per ten-hour day, the driver, fuel, depreciation and lubricants for the motor cost about $8, while the daily expense of a horse-drawn sprinkler is about $3, at least six being necessary to do the work of one motor sprinkler.

The efficiency of the motor device is increased because the water is distributed under adjustable pressure and the forcible washing of gutters is possible. This system is particularly practicable for streets having a double tramway track, as the water can be sprayed sideways and the obstruction caused by the motor sprinkler is reduced to a minimum. The work is done much more quickly than by horse machines, and therefore by a much smaller number of interruptions to the traffic.

The motor driven watering wagon illustrated, is mounted on a 25-h. p. chassis. The tank holds 770 gallons, the water being delivered to two Plainclamps distributors, as used by the City of Paris, by a pump driven from the engine. The control of the distributers is effected from the driving seat, both the force of the spray and the width of service washed being variable to a nicety. The best pace for watering is found to be 7½ miles per hour, and a stretch of roadway up to 65



FRENCH MOTOR SPRINKLING MACHINE *in use in Havre, operated by a 25-horse-power motor.*

feet in width can be treated at one operation. One of these wagons does the work of eight horse-drawn watering wagons.

The motor sweeper works at an average speed of 6¼ miles per hour and on rough roads, or when dealing with thick mud, a speed of about 4½ m. p. h. is acquired. The length of the roller-brush is two meters (6 ft. 7 in.), but it is arranged to sweep obliquely, and its effective track is about 6 feet wide. Not accepting the most favorable figures, the motor brush sweeps a minimum of 17,000 square yards per hour, altho the track swept (6 feet) multiplied by the distance covered in one hour, 6½ miles, equalled 22,880 square yards. Horse-drawn brushes sweep an average of 4,300 square yards, therefore the amount of work done by the motor machine is over five times that done by the horse. The daily cost of a motor sweeper is about $8, including the expense of fuel, labor, depreciation and lubrication, while the daily cost of horse drawn sweeper is about $4. To ascertain how many motor sweepers are necessary the streets are tabulated and classified, separating those to be swept daily, on alternate days and weekly, and then arranged in a program to keep the motors busy.

A percentage must be deducted, as shown above, for overlapping, and 10 per cent. deducted which must be hand swept, in gutters, around obstructions, etc.

Regarding the construction of French De Dion Bouton street cleansing apparatus, it may be stated that the sweeping machines are built on a 14-h. p. chassis, with the engine under a bonnet in front of the dashboard. The sweeping is done by a cylindrical brush carried obliquely from side to side of the frame, the brush being rotated by gear-drive from the differential in the opposite direction to that of the road wheels. All the driving gear is completely enclosed, so that neither dust nor mud can reach it. The driver controls the brush from his seat, a single lever controlling both the brush itself and its driving gear. To lay the dust while the sweeping is in progress, and secure a more effective sweeping than would otherwise be obtained, the machine is provided with a tank holding 250 gallons of water, which is sprinkled just in front of the brush. The sprinkler is worked by a small pinion pump driven off the engine and controlled from the driving seat. The best pace for sweeping is said to be 5½ miles per hour.

The French combined sweeping machines and watering wagons are of unique construction. The motor-driven sprinkler and sweeper is provided with a 570-gallon tank, placed on an 18-h. p. chassis, with engine beneath a bonnet in front of the dash. The machine combines a brush and water-spray of the type used on the 14-h. p. sweeping machines and is provided with a water-distributer like that on the 25-h. p.

watering wagons. There are thirty machines of this type in use in the city of Paris. This is a very convenient machine, especially attractive in cases where a city wishes to try mechanical street cleansing without too heavy an experimental expenditure. By combining as they do, the usefulness of two types on a chassis of medium power, they are very economical and not excessive in cost.

The second illustration shows a Kisselkar street flusher in use in St. Paul, Minn. This car can deliver the water thru the flat flushing nozzles, as shown, at a pressure of about 48 pounds per square inch if desired. The load on the machine is over 3¾ tons and the power is sufficient to carry the machine up steep hills on the first gear. The machine shown in the photograph is climbing the Sixth street hill, one of the steepest streets in the city, and is flushing it on the way.

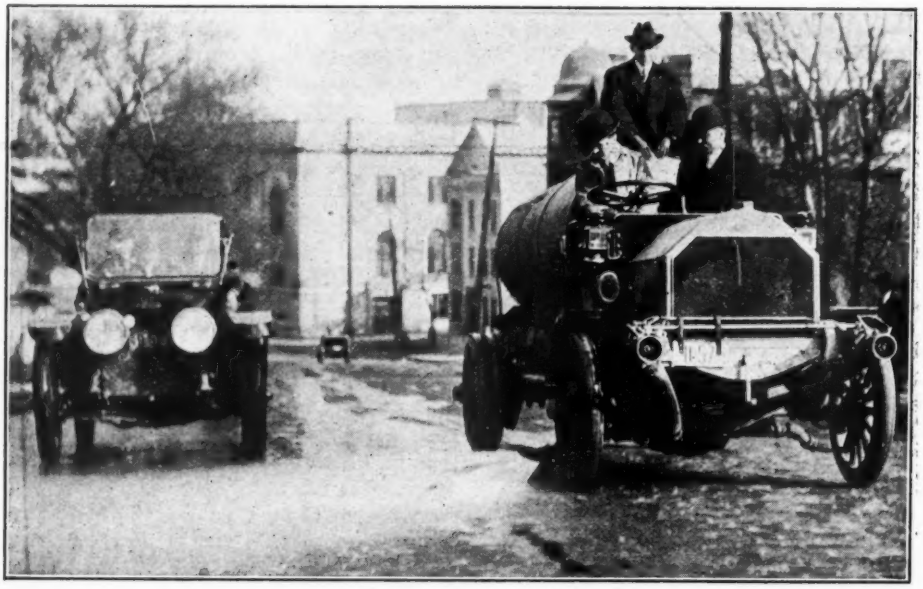
An English motor sprinkler with Mather & Plant centrifugal pump, as developed at Luton, England, with an 1,100-gallon water tank and a motor of 70-h. p. for Canadian service, is shown in the third photograph. This motor sprinkler consists of a 7-ton chassis, fitted with sprinkling and flushing gear and is in use by the street cleaning and scavenging department, of Edmonton, Alberta.

Besides Warwick sprinklers, this English motor wagon is fitted with flushing nozzles which can be arranged at any inclination for use in laying thick dust or for flushing out gutters. The centrifugal pump is placed behind the driver's seat and forces the water thru the flushing nozzles onto the road surface or into the gutters at a pressure of 60 lbs. per square inch.

A new automobile street sweeper, from Sandusky, Ohio, has been developed by Bernard Kern from three steam driven machines and a storage-battery machine built and used in succession, and each an improvement on its predecessor, to the present machine shown in the last of the accompanying illustrations. The four small photographs show the steps in its development. The perfected machine is described as follows:

The sweeper is operated by gas-electric power, having separate motors for the individual parts. The broom consists of fine bassine which enables it to dislodge the finest particles of dust from the pavement, throwing it into the air current which is created by a large suction fan,

KISSELKAR *motor street flushing machine on Sixth street hill, St. Paul, Minn.*



MOTOR STREET SPRINKLER AND FLUSHER *of English design in use in Edmonton, Alberta, Canada.*

the air carrying the refuse thru conduit back into the dirt box. This trailing box is divided into two compartments, one compartment being used as an expansion chamber in which the heavier particles are deposited.

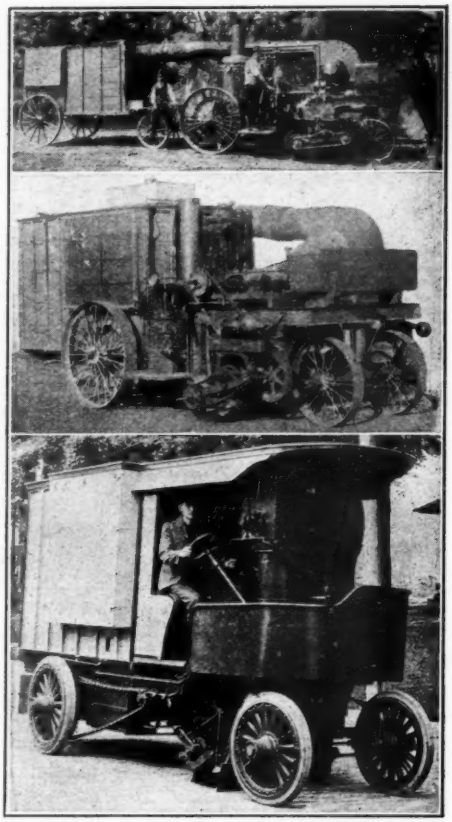
The light dust, which will follow a current of air, is carried into a dust collector, which is composed of a series of cloth pockets, revolving on a drum. These cloth pockets being shaken, automatically deposit the fine dust into a dead-air chamber. The air that passes thru the cloth of this dust collector is again filtered by a series of screens packed with a vegetable matter, thus discharging the air entirely free from dust. When the box has its load it is detached and taken to the dump by a team of horses, and an empty box is replaced, thus eliminating any scattering of dust on the street.

The machine is so adjusted as to adapt itself to all kinds of pavements, being as efficient on the uneven pavement as on the smooth asphalt pavement. The large sweeper is provided with a foot board to carry a helper. When the machine is working on very uneven pavements, the holes in the pavement that are beyond the deflection of the broom are swept out by this helper. Any heavy litter on the streets is picked up by the helper and deposited in a receptacle that is provided on the front end of the dirt box.

From recent experiments made by this company with their machine in Sandusky, Ohio, on an asphalt block pavement swept early in the spring and having the accumulations of the entire winter, the amount of dirt swept up by the machine average eighteen yards to the mile of 30-foot pavement. Some interesting facts will be noted from this test. The expansion chamber in the dirt box contained four yards of heavy material, mostly sand, which averaged in weight 2,040 pounds to the cubic yard, the dead air chamber containing about one cubic yard of dust as fine as flour.

Another test of the machine was on a brick pavement in a business section, consisting of six blocks about one-half mile in length and 40 feet wide, two blocks being of the old kind of pavement having a sand filler for binder, very uneven, and full of holes; two blocks consisting of old style pavement with sand binder and

THREE STAGES *in the progress of the Kern automobile street sweeper, sprinkler and flusher. Upper, steam-driven machine with trailer dust box. Middle, steam-driven machine, self-contained. Lower, storage-battery machine, leading to the latest machine in the larger photograph below.*



being in a smooth condition; two blocks being of the modern type with a cement filler. The first time that the machine swept this territory, the average was three-quarter cubic yard to the block. The pavement was swept again after two days without any attention in the interim by the "white wing" system. The accumulation from this same territory was one and three-quarter yards from the six blocks. It was again swept after one day's accumulation and the amount picked up then was three-quarters of a yard over the entire territory.

In the first sweeping, the heavy material in the expansion chamber averaged about six times as much as that in the dead air chamber, which consisted of fine dust.

MOTOR STREET SWEEPER, *with dust collector and detachable bins, operated by electricity generated by gasoline-driven generator.*

The second time it was swept, the expansion chamber contained about eight times as much as the dead air chamber. The third time, the relative proportion was about ten to one between the expansion and the dead air chambers. After this territory was swept the third time, the pavement was entirely free from dust and by drawing one's hand over the pavement there were no indications of dust left on the hand.

The trailing dirt box can be detached and a watering tank attached, and, if necessary, the broom of the sweeper can be removed and a squeegee attached to scrub the streets. The squeegee developed for this machine is composed of a series of adjustable shovels, each having a flexible shoe, which will enable the shovels to adjust themselves to the irregularity of the pavement.

GOOD ROADS AS CROP PRODUCERS

That an improved road will increase vastly the productiveness of the area thru which it runs, has now beet satisfactorily demonstrated by studies conducted by the United States Department of Agriculture in Virginia. Conditions in Spotsylvania county were investigated with particular care and the results have proved surprising. In 1909, the county voted $100,000 to improve forty miles of roads. Two years after the completion of this work the railroad took away in twelve months from Fredericksburg, the county seat, 71,000 tons of agricultural and forest products, hauled over the highways to that town. Before the improvement of the roads this total was only 49,000 tons annually; in other words, the quantity of the county's produce had risen more than 45 per cent. Still more interesting, however, is the increase shown in the quantity of the dairy products. In 1909 these amounted to 114,815 pounds, in 1911 to 273,028 pounds, an increase of practically 140 per cent. in two years. In the same time shipments of wheat had increased 59 per cent., tobacco 31 per cent. and lumber and other forest products 48 per cent.

In addition to this increase in quantity the cost of hauling each ton of produce was materially reduced. In other words, the farmers not only produce more but produce more cheaply, for the cost of transportation to market is, of course, an important factor in the cost of production. In the past two years the traffic studies of the Federal experts show that approximately an average of 65,000 tons of outgoing products were hauled over the improved roads in the county an average distance of 8 miles, or a total of 520,000 ton-miles. Before the roads were improved it was estimated that the average cost of hauling was 20 cents a ton-mile, after the improvement this fell to 12 cents a ton-mile, or a saving of 8 cents. A saving of 8 cents per mile on 520,000 ton-miles is $41,000 a year. The county's investment of $100,000 in other words returns a dividend of 40 per cent. annually.

Because this saving, in cases of this character, does not take the form of cash put directly into the farmers' pocket there is a widespread tendency to believe that it is fictitious profit, while as a matter of fact it is just as real a source of profit as the increase in the price of wheat.

In Dinwiddie County, Virginia, for example, where peanuts is one of the staple crops, the average load for two mules on a main road was about 1,000 pounds before the road was improved. After its improvement the average load was found to be 2,000 pounds and the time consumed in hauling the larger load to market was much reduced. In other words, one man with a wagon and two mules could do more than twice as much work with the improved road than with an unimproved road. This is the explanation of the extraordinary rise in the total output of agricultural products in a county with a good road system.

MUNICIPAL STREET RAILWAY

OF EDMONTON, ALBERTA, CANADA

The material in this article is taken in substance from the last annual report of the street railway department and shows clearly and without concealment what the condition of the department is and the reasons therefor. It is worthy of the most careful study because it shows, by the comparison of former conditions with the results of modern accounting systems, what cities almost always fail to include in their summaries of cost of operating their public utilities and the resulting deficiencies in operating results. The report recommends methods of preventing these deficiencies and shows where certain difficulties will disappear, and while these are local in their nature they give pointers which other cities will do well to follow.

THE city of Edmonton, the capital of Alberta, Canada, owns most of its public utilities, including its street railway system. The city has recently installed a complete system of accounting.

In October, 1912, a scheme for the provision of depreciation, covering the difference between full depreciation, based on the estimated lifetime of each class of work, and the provision made by the sinking fund was decided upon, to take effect as from the beginning of the new fiscal year, commencing November 1, 1912. This was given effect to, and was made retrospective to the beginning of 1908. All of the utilities and several of the departments, such as police, fire, stores and works, and street departments have made ample provision for depreciation and obsolescence. While this has had the effect of increasing a deficiency in some of the departments, it was necessary to put the matter on a sound basis, as otherwise the true losses of the several departments would not be ascertainable from their accounts.

With regard to the power plant, the basis of provision for depreciation was the ultimate reduction in the cost per k.w. to the equivalent of a modern and efficient plant. With the other utilities, each class of plant has been treated separately. It is the intention to use this reserve fund of the power plant to immediately provide a modern plant to replace the obsolete and inefficient plant, which has been discarded considerably in advance of the periods covered by the several loans from which such assets have been acquired. The ultimate effect of this policy, which it is expected will be completed, so far as immediate replacement is concerned, by 1915, will be that the power and pumping plant will represent the actual physical value for modern and efficient plants of the very highest type. When this is the case, the cost of power will be very materially reduced. It has been suggested that instead of using depreciation and obsolescence fund for replacement, further debenture issues should be made, having the effect of spreading the replacement over a longer period. We feel, however, that such a policy cannot commend itself as sound or wise. Unsound because it will carry assets on the books which are not true assets, and unwise because it will not permit of a reduction in rates that would otherwise accrue. It is true that the creation of this fund in the power plant has been at the expense of the departments which are the only customers of the plant,

but it has been coincident with a reduction in rates to those departments, and the problem of placing the water works and street railway departments on a paying basis is one that should be treated separately, and not at a sacrifice of a sound policy in regard to the treatment of defective assets of the power plant.

There has been a heavy loss in the operation of the street railways department for the fourteen months ending December 31, 1913, amounting to $129,636.99, and after providing the newly established reserve for depreciation, the loss has been considerably increased, and the total deficiency to date is $405,394.07. This utility has been extended considerably beyond the ordinary requirements of the city, the consequence being that insufficient revenue has been obtained. With the extended service that is given to each individual passenger, the tariff of fares is not high enough. It has been put forward that companies charging a 5-cent fare have, in addition to expenses, to provide profit for shareholders. It should, however, be borne in mind that the city pays approximately 5 per cent. interest, and about 3 per cent. for sinking fund, in addition to a heavy charge for depreciation. It might reasonably be held that 8 per cent. for interest and sinking fund is equivalent to the dividend that would be paid by privately owned undertakings. Proposals for an increase in fares, approximating to an all-round 5-cent fare, are under consideration.

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¶ RECONSTRUCTION *of old roadbed, building new barns and buying new equipment for increased business required large capital investments in 1913.*

The work of the department for the year might be emphasized as being a reconstruction of a large portion of the old roadbed and material new extensions, bringing the total mileage up to 50.3 miles, measured on a single-track basis. The more important parts of the system are now taken care of by permanent track laid on a 6-inch concrete slab, filled to the top of the ties with concrete, and finished with a street paving surface. This will reduce the cost of maintenance very materially, besides giving a better class of roadbed on which to operate.

The passenger traffic has increased materially during the year, and also the system has been supplemented by further additions of new cars.

The department moved into its new offices and new car barns and workshops in May, and is now in a position to handle properly and efficiently all car repairs and other items of maintenance required.

The heaviest traffic for any one day during the year was during the exhibition in August, when something over 70,000 passengers were carried.

The freight business of the department has also expanded. This makes possible certain valuable properties being served with trackage which could not otherwise be done direct from the steam railways.

The entire system was carefully gone over at the end of the year, and it was determined to make provision for certain depreciation charges not previously taken care of. This has added quite a burden to the system, but this must necessarily be considered in order to keep the system up to its proper value.

Very little construction work is contemplated for the ensuing year, as there is sufficient mileage to serve the needs of the present population.

It is maintained that, were the street railway to receive all its current without charge, it would still not make a profit on its present showing. This is doubtless true, but it is a simple proposition to state that any reduction will operate towards minimizing the annual loss. If, therefore, it can be shown that the charge for current is unduly high, every energy should be given towards securing that the basis of charge be equitable. From the paragraph on the power plant it will be seen that the street railway is helping to cover within a short period a very large amount of obsolescence in the power plant. If the present policy is carried out, the street railway can look for no relief under this head for nearly two years yet, after which there should be a substantial reduction in the cost of power.

In comparing the charge for street rail-

way current in Edmonton with other cities, care should be taken to ascertain the method of measurement. Up to November last the Edmonton street railway had to pay 2.4 cents per kw. hr., but of the total current approximately 80 per cent. was alternating current and only 20 per cent. direct current. The loss on conversion of the former is fully 20 per cent., raising the real price of the current to almost 2.8 cents. About the same time that the rate was reduced to 2 cents, the introduction of new machinery made the proportion of A. C. and D. C. about 50 per cent. each, or equal to 2.2 cents all round on a D. C. basis.

The benefit of the reduction only affects the last two months, and the rate is still high. If the power plant problem were solved by the transference of its obsolescence to general taxation, the street railway would stand to receive a substantial credit as its share of the power plant's "revenue surplus," and would be at once relieved of any further contribution to power plant obsolescence.

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¶ DEVELOPMENT *of system beyond present needs has caused deficit which is offset at least in part by favorable ef-* *is offset, at least in part, by favorable effect on city's growth.*

Probably the two most important factors which contribute to the lack of success that has hitherto marked the history of the street railway are:

The geography of the city itself, and the fact that the development of the street railways is substantially ahead of that of the city.

Edmonton has developed in easterly and westerly directions, owing to the presence on the north of the Hudson's Bay reserve and on the south of the Saskatchewan river. Both of these are responsible for long hauls with little chance of intermediate fares.

Unremunerative lines include the Bonnie Doon, Whyte Avenue West and the Low Level Bridge services, which the city is obliged to maintain under the Strathcona amalgamation agreement. Another unprofitable service is the Athabasca avenue line. In these instances, if in no others, there seems little doubt the street railway is built ahead of present requirements, and has thus to meet sinking fund and interest, and operation and maintenance charges, which are not nearly equaled by the revenue derived.

Notwithstanding statistics to the contrary, it would appear that the street railway has been extended into districts where there is not yet a sufficient population to justify the construction of the lines, if viewed from a purely commercial standpoint. For the present the railway has to maintain these services, and it is to be hoped the facilities of transit afforded thereby will so develop the districts in question that the services will, in the course of time, be remunerative. Meanwhile the street railway is burdened with the heavy deficit of $405,394.07, to carry which it has no funds of its own, and must, therefore, suffer heavy interest on this sum, in addition to its ordinary charges.

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¶ METHODS OF REDUCING *annual deficits are suggested, and the largest source of last year's deficit is shown to be due to equalization of depreciation accounts, now permanently taken care of.*

Seeing there is little prospect of material improvement in the near future, and as the street railway has suffered considerably by being required to furnish the citizens with transit facilities which cannot as yet be other than unprofitable, there seem good grounds for the council to consider means whereby this deficit may be cleared off and the street railway be given a fresh start. There are two practicable ways.

One is to wipe out the power plant obsolescence; refund the street railway its share of the overcharges already made; reduce the price of current to cost; and raise additional revenue by increasing fares to a straight 5 cents, with reduced fares only to workmen and children.

The other way is to raise sufficient money from general taxation to clear off the deficit, in either one or two years, and to raise fares until it can be demonstrated that the street railway can afford to reduce same and still pay its way.

Capital expenditures during the fourteen months were $1,421,145.32, mainly for new track, rolling stock, new car barn, overhead trolley wire, high level bridge and land.

The revenue and expenditure report for the fourteen months' operation shows a deficit of $191,934.62; of this amount, however, $63,289.12 is a special charge against revenue for dismantling the old car barns and for depreciation. The actual loss on the fourteen months' operation, excluding this amount, is $98,545.50; the receipts for the past year increased from $437,495.62 to $727,720.10; however, as already stated, this revenue is for fourteen months, against twelve months in the last annual report, and the actual increase in the receipts is 43 per cent. This increase is very small, compared with the percentage of increase experienced by the department during the two previous years; the increase in the receipts for 1912 and for 1911 was 78.4 per cent. In making provision for the 1913 operations the department estimated that the increase in receipts would be approximately the same as in previous years, and based all their calculations on this assumption. It is a well-known fact now that the year 1913 was a disappointing one in the west; the increase in population, which had been phenomenally rapid in the city, did not continue at nearly the same rate, and, in consequence, the receipts of the department suffered; at the same time the receipts also suffered to a great extent during the summer months, owing to the large amount of construction work which was under way. These two circumstances will explain the reason for the increase in receipts during 1913 not being as great as in previous years. Even with the increase recorded the department shows a very gratifying increase in revenue. An increase of 43 per cent. under the adverse conditions experienced speaks very well for the future prospects of the city in general and the department in particular.

The percentage of working expenses to gross receipts has this year shown a distinct improvement, this percentage being lower for 1913 than for any year since the system started, with the exception of 1909. The improvement is all the more noticeable because the past year was an extremely arduous one, as for several months the traffic had to be carried over tracks in course of reconstruction, which all meant an increase in the working expenses; also, during the time that the construction work was going forward changes had to be made from time to time in the routing of the cars. This not only meant actual loss in traffic, but meant additional transferring, longer hauls and a generally unsatisfactory service.

The following are some figures in connection with the department for 1912 and 1913:

	1912	1913
Total number of cars	50	80
Number of car miles	1,203,260.27	1,899,336.00
Number of passengers carried	10,307,422.00	14,973,781.00
Journeys per head of population per annum (on the basis of 53,000 population)	194	
Journeys per head of population per annum (on the basis of 67,000 population)		224
Average number of passengers per day	28,162	41,024
Average number of car miles per day	3,288	5,204
Number of passengers carried per car mile	9	7.89
Average fare per passenger	4.06	4.08
Earnings per car mile	36.2	33.2
Expenses per car mile	36.06	42.7
Number of passengers per car per annum	429,476	417,097
Revenue per car per annum	$18,226.96	$17,820.85
Date of heaviest traffic	Aug. 15,1912	Aug. 14,1913
Number of passengers carried on that date	65,400	70,344
Number of motormen and conductors	156	251
Passengers carried per mile, single track basis	340,000	285,000
Earnings per mile, single track basis	$14,500.00	$11,940.00

GARBAGE INCINERATORS AND DESTRUCTORS

By Sterling H. Bunnell, New York City.

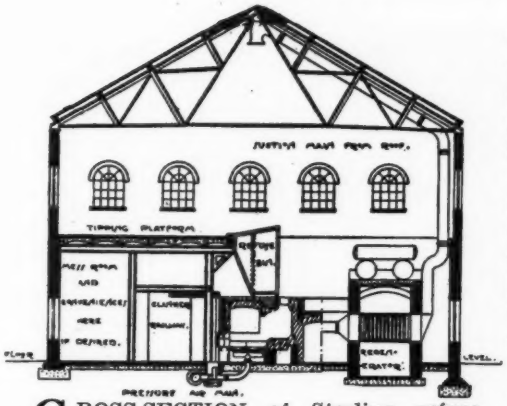
The author of this article is experienced in the solution of garbage disposal problems and here shows the fields of garbage reduction and of garbage and waste destruction. He then describes the processes in the modern English type of refuse destructor with references to various plants of this sort in operation on this continent, and illustrates his description by photographs of outside and inside of one of the latest plants put in operation, that at Berkeley, Cal.

THE disposal of the garbage and refuse of cities is becoming one of the great problems of municipal life. In the early stages of a city's growth the rubbish and refuse is usually dumped in hollow places or on low lands, and serves as filling material. As the city increases in size the amount of refuse increases in proportion and land becomes less accessible from the thickly settled parts of the town. A rubbish dump creates a nuisance, is a menace to health, and a fire risk as well; while the dumping of garbage along with refuse increases the nuisance tenfold. The garbage disposal problem generally comes up as one of the serious questions before the city authorities long before the city has grown to what may be called large size.

The waste of cities may be divided into three classes: Garbage, comprising putrescible refuse, table scraps, commission house offal and other waste from food substances, to which is occasionally added the carcass of a dead animal. Ashes from house fires and factory furnaces are produced in large quantities, and comprise the only form of city waste which can be safely used in filling low ground. Ashes can also be used to some extent in road surfacing in the suburbs. The third class of waste is dry rubbish, comprising waste wood, sweepings, lawn cuttings, branches from shubbery, paper, rags, old shoes and other cast-off articles.

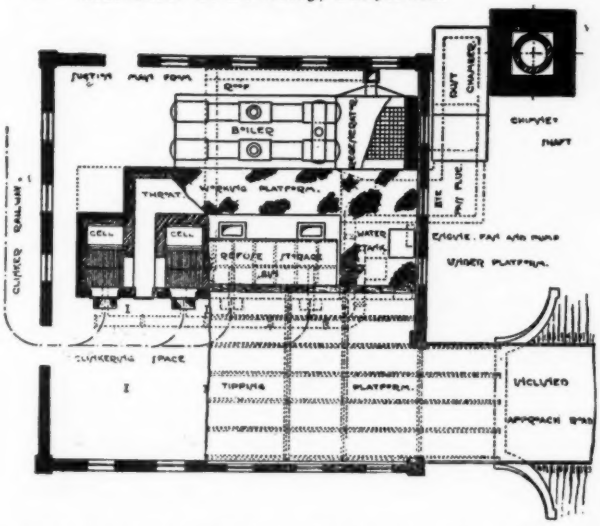
The three classes of waste, if obtained in sufficient quantities, can be advantageously treated separately. In cities of large size, where the class of garbage alone amounts to one hundred tons or upwards per day of twenty-four hours, the reduction system has many advantages. The garbage is collected in steel wagons, delivered to a reduction plant situated at a proper distance from the thickly settled portions of the city, and there converted by cooking and pressing processes into grease and tankage. In these operations a large quantity of stick-water is produced, which, if allowed to run to waste, creates a nuisance and is extremely unsanitary and objectionable. In order to dispose of the stick-water, which carries a considerable percentage of material which can be recovered as tankage, it is necessary to provide evaporators and to drive off the water as harmless steam, while the stick-water is concentrated into thick tankage and added to the product of the plant.

The products of a reduction plant are: grease, which may be classified, refined, and separated into various grades and sold for making soap and for other purposes; and tankage, which is useful in manufacturing fertilizer. If the operation is carried out on a sufficiently large scale, stated above to be not less than 100 tons per day, the profit is likely to be sufficient to make an attractive return on capital. In smaller quantities the reduction operation is almost sure to show a loss, unless all attempt to carry on the process inoffensively is abandoned and the foul and



CROSS-SECTION *of Sterling refuse and garbage destructor at Berkeley, California.*

PLAN *of Sterling refuse and garbage destructor at Berkeley, California.*

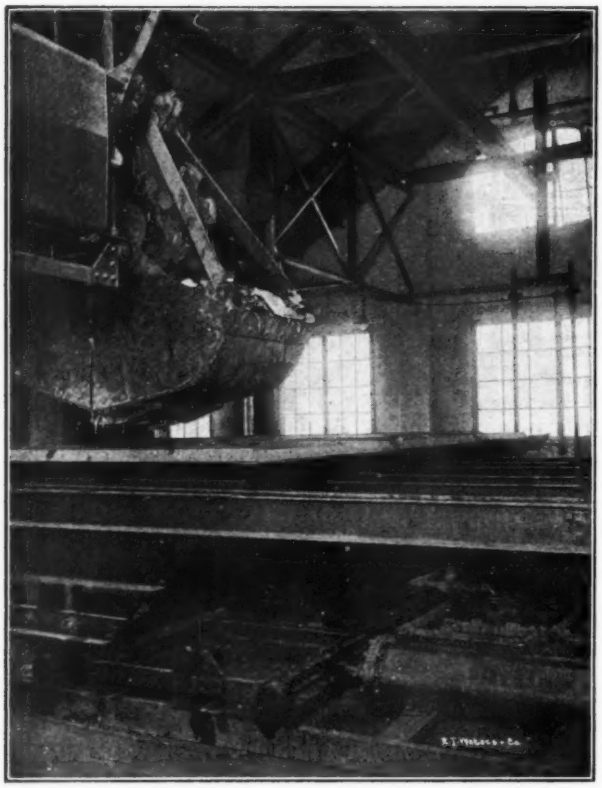


putrefying stick-water allowed to run away in the nearest stream. Small cities operating reduction plants are invariably burdened with a serious nuisance, as can be readily verified by inquiry among the inhabitants of such places.

The situation with regard to disposal of municipal wastes came to a crisis in Europe some years ago. In consequence, the most advanced methods of waste disposal originated across the ocean. The inhabitants of European cities waste far less of their food material than is the practice in America, so that the quantity of garbage per inhabitant is extremely small, and its value for reduction purposes is slight. There being no incentive, therefore, to separate garbage from other wastes, the plan was adopted of destroying the mixed refuse of the city in large high-temperature furnaces. The English destructor system, by which the entire waste collection of a city, or a portion of the city, is delivered to a destructor plant, and there burned under forced draft, in connection with steam boilers by which power is obtained from the waste heat, has now been widely adopted by cities thruout the world.

Many American cities have as yet done nothing in the direction of the sanitary disposal of municipal waste. Owing to the large free spaces which surround the smaller cities, it has usually been possible to carry on dumping operations, or feed the garbage to pigs, and to change the location of dumps when conditions become unbearable. Comparatively few of the smaller cities have been forced to instal incinerators for destroying garbage, or reduction plants for utilizing its values. But the time has already come when the conditions have become so serious that many cities are studying the best solution of the waste disposal problem. Since the reduction plant cannot be operated on a small scale without nuisance, except at a heavy cost for operation and maintenance, the simplicity and convenience of the incinerator makes the latter the only feasible apparatus for waste disposal in small cities.

Incinerators are intended to deal with garbage and rubbish as collected, and not to handle ashes or large quantities of noncombustible material. Two kinds of incinerators may be recognized. One attempts to provide storage space within the furnace for the entire day's collection of garbage, and to dry the wet mass slowly by heat previously accumulated in the furnace walls, and supplied by a coal or oil fire kept up in a combustion chamber below the material. The system has the ad-



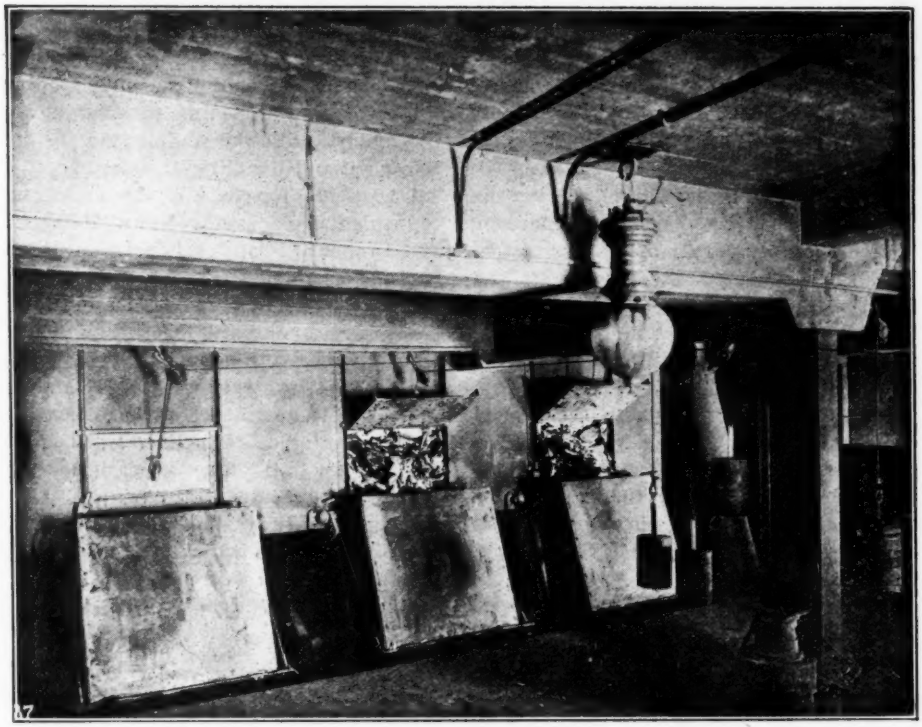
CHARGING FURNACE *with garbage by means of grab-bucket.*

vantage of taking the entire day's collections at one time, thereby reducing the time and labor at the plant. It disadvantage is the impossibility of maintaining in the presence of the mass of wet material temperature sufficient to destroy the noxious odors. Incinerator plants of this character should be provided with tall chimneys, and are never safely located within the limits of a settled portion of the city.

Incinerator furnaces operating at high temperature have been successfully installed and operated in a number of cities. Such furnaces are constructed of fire-brick throughout. They provide a fire-brick surface on which the garbage and refuse may be charged in reasonable quantities at intervals of thirty to sixty minutes, and a fire grate on which quick combustion, at high temperature, may be kept up by firing the dry rubbish collected along with the garbage, or using coal or other fuel if the quantity of rubbish is deficient, or the collection too wet on account of rain. In the brick-lined destructor furnace it is possible to keep up a temperature above 1,250 degrees, and thereby to destroy organic gases, and positively prevent the escape of disagreeable odors from the plant.

Destructor furnaces may be used in connection with steam boilers, if desired, and steam power may thus be developed for any useful purpose. In this way large department stores and city buildings may utilize the waste material which is collectible in large quantities, and supply steam to the power plant of the building. Large works may dispose of rubbish of all kinds, including sweepings, restaurant scraps and every form of combustible waste, whether wet or dry, while realizing from the waste heat a large amount of steam power. In cities and towns up to populations of 25,000, destructor furnaces with steam boilers in connection, may provide power for municipal lighting, for sewage pumping, or for the heating of city buildings and other useful purposes.

Where the quantity of rubbish and garbage collected reaches upwards of one hundred tons per day of twenty-four hours, the English destructor system has marked advantages. The destructor receives and destroys all material collected, making it unnecessary to separate garbage from refuse and ashes, and requires only one collection instead of three. The temperature at which the material is destroyed precludes the possibility of creating a nuisance in the neighborhood. In the City of London, the Boro of Bermondsey has a destructor installed in a city block containing a school, a city building, a library and a number of residences, and surrounded by closely built blocks of resi-



FRONT *of garbage and refuse hopper, showing container system.*

dences on three sides. This particular destructor is now operating after some fifteen years use, at greater capacity than originally intended and is receiving the refuse collections from an adjacent boro as well as its own regular collections.

The high-temperature destructor consists of two or more separate cells or furnaces, each provided with a grate and a drying hearth at the rear. The forced draft is supplied to each cell by a perforated air pipe opening in the ash pit. The gases of combustion pass thru the cells from one to the next and enter a combustion chamber, in which the temperature may go as high as 2500 degrees. From the combustion chamber the gases are led thru the heating passages of a steam boiler, thence thru a regenerator or air heater and to the stack. The air for forced draft is taken generally from the roof spaces of the destructor house, thus providing efficient ventilation and means for the removal of dust. The ventilating ducts lead to the intake side of a pressure fan, by which the air is forced thru the heating passages of the regenerator and thence thru air pipes controlled by convenient valves to the perforated discharge pipes under the grates.

In the operation of a destructor, the garbage, refuse and ashes, mixed as received from the collecting wagons, is fired, either thru charging holes in the top of each cell, closed by sliding covers lined with fire brick, or thru doors in the back wall of each cell. The damp material falls on the drying hearth referred to previously, and is acted upon by the heat from the material burning furiously on the grate surface in front of the drying hearth. In this way vapor and fumes are driven off and consumed thoroly in the passage thru cells and combustion chamber. As the material on the drying hearth becomes dry, it takes fire and commences to burn rapidly. The stokers now pull forward the charge from the drying hearth and spread it over the grates, and introduce a new charge of fresh material upon the drying hearth.

The cells are operated alternately, so

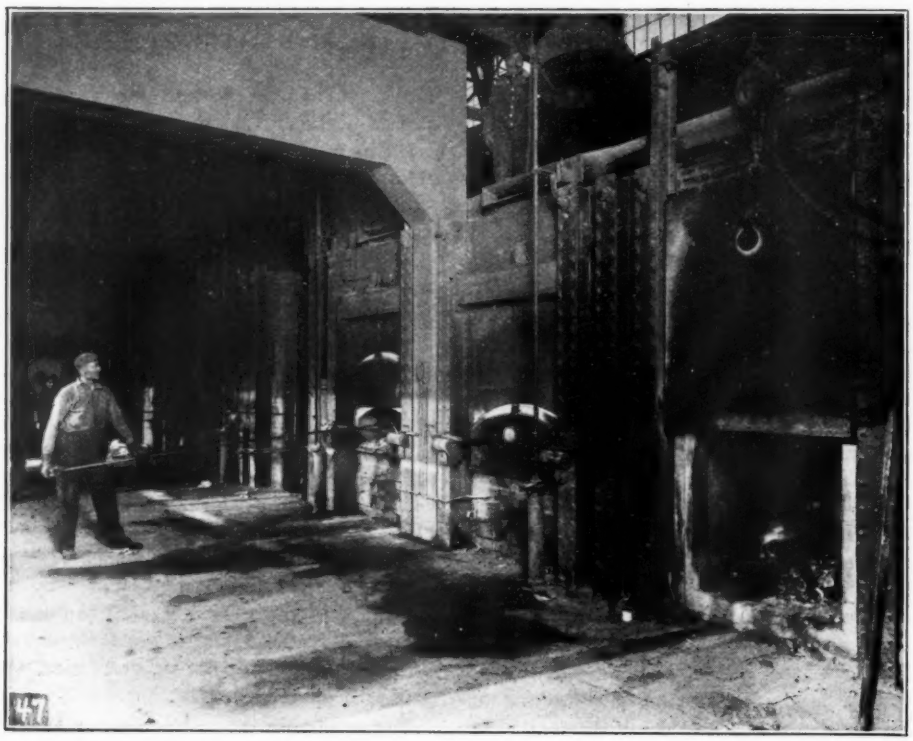
that one is always burning brightly while another is being charged. In this way there is always sufficient heat and flame to destroy the escaping odors and vapors. As the material burns on the grates it forms a hard clinker, which must be removed from time to time by stoking.

Mechanical charging and clinkering devices have been developed with more or less success, for use in the larger plants. The most convenient method for stoking the garbage into the furnaces is the top-feeding system. The building for this method is preferably constructed against a side hill, on which a road can be laid giving access for wagons to the second or dumping floor of the building. The garbage in this way is dropped into hoppers above the furnace and raked from these hoppers into the charging cells as required. During the operation of charging, the blast must be shut off from the cell being charged, or flames may issue from the charging hole and ignite material in the hopper. To prevent such accidents, and for greater convenience in charging, mechanical charging mechanism has been developed, by which material required for one charge of a furnace is first placed in a container or bucket, which at the proper time is moved over the charging opening, the cover of the opening withdrawn, and the material allowed to fall into the cell below without handling or delay.

Where the top-charging system is not convenient, because no side hill is at hand and an inclined runway is not wanted, the garbage carts may dump on the floor level of the building, and the material may be carried by a grab bucket and crane from the receiving hopper to the charging containers above the furnace. A simpler method is to dump each garbage cart into a skip running on an inclined track. After receiving a load of garbage, the skip is hoisted by machinery to the top of the building and there dumped into a charging hopper, from which it is raked into the furnaces as required.

Clinkering a destructor furnace is gen-

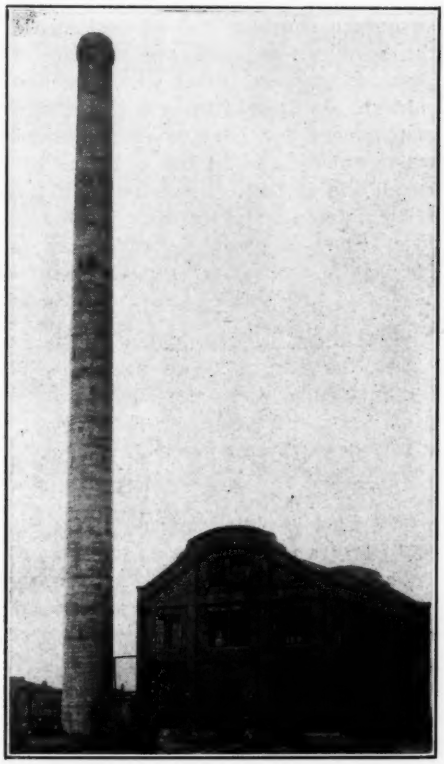
FURNACE DOORS *of rubbish destructor, showing operation of removing clinkers from grates.*



erally performed by hand, and is an extremely difficult operation to perform by machinery. Destructor furnaces commonly receive all kinds of waste material, including pieces of wire, nails, glass, iron rods and other articles which often lock in the grate spaces or melt and run into solid masses of clinker, difficult to dislodge except by direct attack with a slice bar and poker. One method of mechanical clinkering is to provide the furnace with grates constructed in the form of a trough, and to lay in this trough a zig-zag iron bar which will become incorporated in the mass of clinker. When a large body of clinker is formed, a wire rope from a small windlass is hooked to a ring in the end of the bar and the whole mass drawn forward out of the furnace onto a steel car and thereby taken out of the building. Another method of clinkering is to provide a hydraulic plunger in the back of the furnace. By moving the plunger forward, the mass of clinker will be lifted and shoved out of the furnace to fall in the clinker car. Various forms of dumping grates have also been tried. But, at the present time, none of the mechanical systems of clinkering is in successful operation in the United States. The difficulties in the way of clinkering mechanism, thru the presence of foreign substances in the clinker, and the general difficulty of removing heavy masses of molten clinker and ash, have been insurmountable.

Destructor furnaces of the English type are in operation in a number of cities on the American continent, among which may be mentioned Montreal and Halifax in Canada, the Boro of Richmond in New York, Paterson, N. J., Pittsburgh, Pa., Berkeley, Cal., and others. There are several large plants under construction or test, and the use of the system will undoubtedly increase rapidly in the near future. Many cities are inquiring today for information regarding the plants already in operation, and much interest has been aroused by the performances of the many successful plants.

A destructor plant, housed in a neat and handsome building, is a source of pride to the municipality owning it. No nuisance whatever occurs from the operation of such a plant, if well managed. Deterioration is not rapid, nor is the apparatus complicated and difficult to handle. Ordinary laborers are easily taught to be successful stokers in such plants. By proper planning in advance, a destructor plant may always be located on a site conveniently near the centre of the collection district and at a point where the steam produced, or electricity generated by engines operated with the steam from the destructor boiler, may be used by the city or sold to adjoining private parties. In many cases the operation of destructors is found to be a source of profit sufficient to cover the cost of collecting garbage. As between the filthy and unsanitary method of dumping the garbage and rubbish collections on vacant lots, or feeding pigs in



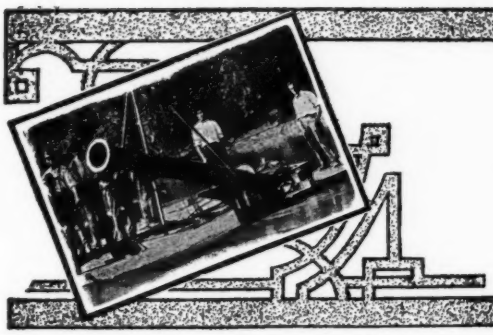
STERLING DESTRUCTOR *for garbage and refuse recently erected at Berkeley, California.*

municipal pens, and the efficient and sanitary disposal of rubbish and garbage in destructor plants, the choice is all in favor of the destructor system, and this system is the only one which can afford a profit in cities of moderate size.

The larger cities, in which the collection of garbage alone reaches seventy-five to one hundred tons per day, may with advantage consider the establishment of three collections, and the separate disposal of garbage, ashes and combusible rubbish. In these cities, a destructor finds employment for burning the unsalable waste rubbish, as in the cities of Pittsburgh and Buffalo. Ashes being disposed of by dumping, and garbage by shipment to a reduction plant, the remaining rubbish can be sorted over a picking belt and separated into salable and unsalable portions. The worthless rubbish burned in high-temperature destructors furnishes power for the operation of the picking belt, and a surplus of electricity for lighting and for sale to other plants in the neighborhood. A further economy is possible, though not yet adopted by any American city. This is to utilize the worthless combustible refuse for furnishing heat to the reduction plant. This may be done either by baling the worthless refuse after sorting, and shipping it to the garbage plant, for which purpose it would be worth as much as coal at $2 per ton; or by delivering all the rubbish to the reduction plant, and there picking out the salable portions. In the average city collections, there is enough heat obtainable from the rubbish to provide most of the heat necessary in the reduction operation.

ECONOMIC SIDE OF GOOD ROADS DAYS

The other day the Governor of the State of Idaho, two ex-Governors, the Mayor of Caldwell, bankers, professional men, merchants, and well-to-do citizens generally, to the number of 300, donned overalls, shouldered picks and shovels and sallied forth to do a bit of road work in the neighborhood of Caldwell. It must have been a grand and inspiring sight to see these men with soft hands and untrained muscles going valiantly to show by their works their faith in the good roads movement, and incidentally to garner a bounteous harvest of blisters, sunburn and backache. It is safe to say that not more than 5 per cent. of those volunteers was efficient or even practiced in the handling of pick and shovel. That is, fifteen of them could do a full day of effective work without going to the hospital afterward, and the other 285 just cluttered up the ground and were more or less in the way. It also is a safe guess that the one day of work represented as costly a bit of road-building as has been done anywhere in this land of wasteful effort. Taking the average earning capacity of the volunteer shovelers and pickists, in their own vocations, at ten dollars a day—certainly a conservative estimate for such men—the cost of that one day's work, in wages alone, was $3,000. Fifty practiced and efficient shovelers could have done more and better work in the same time and at a wage of only $150. But we must have spectacle and hoorah, brass band and tinsel, or we feel the entertainment committee is not doing its duty. It would not have been enough like a show for the governor, et al, to make up a purse of $3,000, hand it to some competent road-maker and ask him to get the most for the money. For example, $3,000 would have paid the highest of wages to the fifty expert shovelers for twenty days. Yet, with such spectacular, inefficient, wasteful, and unbusinesslike exhibitions before us every day in all parts of the land, we wonder why we do not get more substantial results from our taxes and other expenditures, and why it costs us so much more to live than it did our fathers.—*Engineering-Contractor.*



EDITORIAL

FIRE PREVENTION.

The Fire Underwriters are pointing the moral of the Salem fire by showing that everything which happened was predicted in their report on the fire hazards of the city and that if their recommendations had been followed the conflagration would have been prevented. An asbestos roof saved one factory. Automatic sprinklers prevented complete burning of the contents of three reinforced concrete factories which had caught fire from outside. A brick wall stopped the spread of the fire in one direction. Wire-glass windows kept the fire out of one power house and one factory.

These are the bright spots in the story of the burning of a district with frame factories and dwellings, shingle roofs on brick and concrete buildings, carelessness in handling dangerous materials, only nine firemen on duty, defective hydrant, reduction of water pressure with breakage of sprinkler feeders in two burned factories and no gates to shut them off, poor water supply thru small distribution reservoir and small distribution pipes, cement pipes preventing high pressure connection with the Peabody supply, low tide in canal, preventing use of that supply by steamers from other towns and cities not equipped to use style of hydrants in Salem.

The combination of hot weather, high wind and delay in first attack of fire or any two of them will produce a conflagration in a wooden town. Salem had all three. Fire-proof buildings in groups will not stop a fire under such conditions, because brands spread it thru long distance jumps.

Cities are often slow to heed the recommendations of the National Board of Fire Underwriters and its engineers, and protest because insurance rates are not decreased or are increased pending their action upon such recommendations. The possible consequences of such neglect are shown by Salem's disaster and the good judgment of the Underwriters in delaying reductions in rates until the improvements in public fire protection and in private fire prevention are fully installed is clearly demonstrated. Will other cities move any more quickly because of these demonstrations?

ANCIENT COMMISSION GOVERNMENT OF CITIES.

The commission form of government of cities has been shown to be much older than that established in Galveston, which has been the moving cause of the rapid spread of this form of municipal government within the past ten years, but now comes the Civic Government League of Edmonton, Alberta, and demonstrates that it is over seven hundred years old, by

quoting from King John's charter to the boro of Northampton, England, in 1200, as follows:

"We decree also that in the said burgh of Northampton there shall be elected by common choice of the burghers, four of the more learned and discreet citizens, who shall care for the revenues of the Crown and other matters which to us and our Crown in that burgh pertain, and who shall see to it that the citizens of the said burgh, both rich and poor, shall act justly and according to law."

Many other English city charters are in similar form and the most modern development is back to this early form. The more "democratic" form of government which has prevailed in American cities since the founding of the United States seems to be less efficient and to be more or less discredited on that account. Mr. Carl Gayler, before the St. Louis Engineers' Club, recently presented a rather intemperate defense of this democratic form, which had some effect in modifying details in the proposed new St. Louis charter, but did not modify its general principles. However, while it is less democratic than the common form of city government, the St. Louis charter does not provide for the full commission form, but for a modified form, which will probably be more satisfactory for so large a city. It has just been adopted by a small majority.

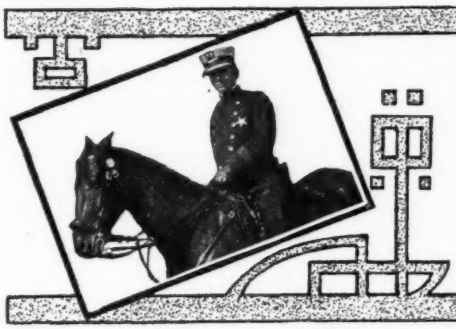
CHICAGO'S INVESTIGATION OF TERMINALS.

A body of representatives of the city of Chicago is at present in Europe engaged in a study of railroad terminal problems, at least this subject is reported to constitute the main purpose of the trip. Other subjects, such as the vice question, will also receive attention during the trip.

Chicago has been liberal in its investigations of various problems but, in spite of such studies, it does not seem to be making material progress in developments or improvements. The present investigation of terminal problems in Europe with a view to applying the result of the study in the perfection of a plan for solving Chicago's terminal problem does not seem to be founded upon good judgment. Chicago is the world's greatest railroad center and the physical operation of its terminals is probably more complex than that of the terminals of any other city in the world. Basic principles which serve satisfactorily in the case of London or Paris could hardly be applied in Chicago. Chicago's problem is individual. It must eventually be solved by the application of sane and economic principles in which not only the city government but the railroads themselves could reasonably concur.

It is a well-known fact that electrification has been much discussed in Chicago, especially among politicians, as a panacea for all the ills and inconveniences of steam operation and also as the basis upon which a comprehensive terminal plan could be developed. If it is possible to judge by the progress which has been made by the electrification of steam railroads thruout the world, it is evident that electrification is still in its infancy and it is probable that many important modifications of present methods may be made within the next decade or so.

Our judgment is that Chicago could more profitably engage in an intelligent study of the engineering, financial and operating problems involved in its railroad and terminal situation, work in connection with which could be better conducted at home than upon any vacation tour, no matter how well conducted or well financed.



QUESTION DEPARTMENT

Proposed Municipal Creosoting Plant

We would like data as to a creosoted block plant capable of turning out enough blocks a day to cover 1,000 square yards. There is an endeavor to establish such a plant at the city workhouse in a certain city.

T., Chicago, Ill.

A plant simply for creosoting blocks only is a comparatively simple affair, containing space for lumber, a sawmill, tanks for holding the oil and for heating it when necessary, the pressure cylinder and cages and tracks for handling blocks in and out of it, air pumps for exhausting air from cylinders, pumps for putting pressure on the cylinders and pumping oil, water and steam, a steam plant sufficient to furnish steam for the process, as well as for operating the machinery.

If the oil must be prepared, stills for that purpose must also be provided.

The amount of unskilled labor required about such a plant is rather small, especially one of the capacity named.

The plant should be specially designed by an expert and one should be consulted in making the preliminary plans and estimates.

E. B. Badger & Sons Co., 75 Pitts street, Boston, Mass.; Eppinger & Russell Co., 165 Broadway, N. Y.; S. P. Sharples, Barrett Mfg. Co., Boston, Mass., can give information and aid in the study of the problem.

Village Wants A Water Supply

Our village has a population of less than 2,000, with water 16 to 25 feet from surface of ground, which here is sand and gravel; well can be driven and yielding water in less than an hour fit for domestic use. Do you think it probable we can get any company to take a franchise here to supply water to the inhabitants and for fire protection, street sprinkling, etc.? M., ————, Ill.

The village itself wants water for fire protection, street sprinkling, fountains, school and other public buildings. Some of the inhabitants want water for domestic purposes. The process in the past has been to grant a franchise to some one to furnish the water on terms dictated by him and to allow him to take all the risk and all the profit. Since the establishment of state public service commissions the process is not so satisfactory, since the state commission can step in and modify rates at any time and may not allow the profits which the holders of the franchise think are due them. It is, therefore, necessary to reduce the amount of risk in assuming the obligations of the franchise to conform with the diminution in the possibilities for large profits.

The village can do this by making a preliminary plan and estimate of cost of building and operating the plant and getting some idea of the revenue which can be developed from private consumers.

The revenues must meet the expenses and capital charges and whatever the revenues from private customers lack of doing this must be raised. If the desire of the village for the water supply is strong enough, the village board can agree to pay enough for fire protection and public uses of water to meet the deficiency. If this annual payment by the village is more than its fair share of the total annual charges to be met, it can be reduced from year to year, as the income from private consumers increases, until a fixed minimum is reached; after which any excess in receipts over charges can be divided between company, private consumers and village at large in a manner to be agreed upon.

An agreement made on these general lines removes all uncertainties, so far as the investor in the plant is concerned, and it should therefore be easy to find some person or company who will be willing to make the contract and build and operate the plant.

What the village needs first, therefore, is an engineer experienced in modern contracts and franchises who can make the preliminary plans and estimates and prepare the form of contract or franchise. His fee will be well invested and will save the village and its citizens many times the amount, if, indeed, under present conditions, it does not turn an impossibility into a satisfactory reality.

Municipal Quarries

We are desirous of finding out what cities, either in the United States or abroad, have municipal quarries. We would like, also, if possible, to find out whether these have been successful or not. We will appreciate any information you can send us in this respect.

J. D. R.,
Minneapolis, Minn.

The latest report by the Bureau of Census on general statistics of cities for 1909 reports the following municipal quarries in the United States:

St. Louis, Mo., and Nashville, Tenn., each moved over 64,000 cubic yards of stone from their quarries; Oakland, Cal., and Washington, D. C., over 25,000; San Antonio, Tex.. Everett, Mass., Auburn, N. Y., over 15,000; Somerville, Mass., and Rockford, Ill., over 10,000; Atlanta, Ga., Louisville, Ky., Quincy, Ill., Augusta, Ga., Newton, Mass., and Manchester, N. H., over 5,000; Haverhill, Mass., Kansas City, Mo., Duluth, Minn., over 2,000, and Kansas City, Kan., and Dubuque, Ia., less than 1,000. San Antonio, Tex., is reported to have sold $600 worth of stone in 1911, but no other city gives either receipts from stone sold or cost of operating quarries.

Ordinances Providing For Vehicle Licenses

Can you give us any information in regard to "wheel tax" ordinances, ordinances taxing vehicles for the maintenance and repair of the streets? We should like to know what cities have such an ordinance now in operation; whether or not there are ordinances of this nature, which do not make provision for using the income for the maintenance of streets, and what the usual rates are.

M., Madison, Wis.

The number of cities assessing vehicle license taxes is not large. Of the 193 cities of over 30,000 population included in the United States Census report of financial statistics of cities for 1911, only 29 are reported as collecting license fees for horse-drawn vehicles, from which they derived $1,112,469 of revenue.

Twenty licensed automobiles and fifteen motorcycles, collecting $59,524. Four licensed motor operators, collecting $6,338. The returns for 1912 show somewhat less revenues in that year.

The names of cities collecting vehicle licenses are not given definitely, but the following seem to have such ordinances; there may be a few more: Chicago, Ill.; St. Louis, Mo.; Pittsburg, Pa.; Buffalo, N. Y.; Cincinnati, O.; Los Angeles, Cal.; New Orleans, La.; Washington D. C.; Kansas City, Mo.; Indianapolis, Ind.; Louisville, Ky.; Denver, Colo.; Portland, Ore.; Columbus, O.; Oakland, Cal.; Birmingham, Ala.; Dayton, O.; Spokane, Wash.; San Antonio, Tex.; Kansas City, Kan.; Duluth, Minn.; St. Joseph, Mo.; Oklahoma City, Okla.; Evansville, Ind.; Jacksonville, Fla.; East St. Louis, Ill.; South Bend, Ind.; Wichita, Kan.; Covington, Ky.; Mobile, Ala.; Springfield, O.; Little Rock, Ark.; Wheeling, W. Va.; Galveston, Tex.; Elmira, N. Y.; Hamilton, O.; Quincy, Ill.; Charlotte, N. C.; Newport, Ky.

Some of these license automobiles only. Some of them license horse-drawn vehicles and not automobiles; thus the cities in Indiana are prohibited from charging license taxes on automobiles, the state collecting them.

Whether the proceeds are used in maintaining streets depends on constitutional provisions and on the needs of the city in other directions. In some states all the proceeds of licenses must go to certain designated funds or to the general fund. In the latter case the fund can be appropriated for street maintenance. Oklahoma City passed an ordinance charging license fees on automobiles and appropriating the receipts to maintain a certain named boulevard. Not many states give their cities as great freedom as this. The proceeds as reported in MUNICIPAL ENGINEERING, vol. xliii, p. 260, were estimated at $12 000 a year.

The city of Cincinnati, O., probably has the most elaborate and inclusive ordinances regulating vehicle traffic and copy of that ordinance will answer most of the questions that may arise.

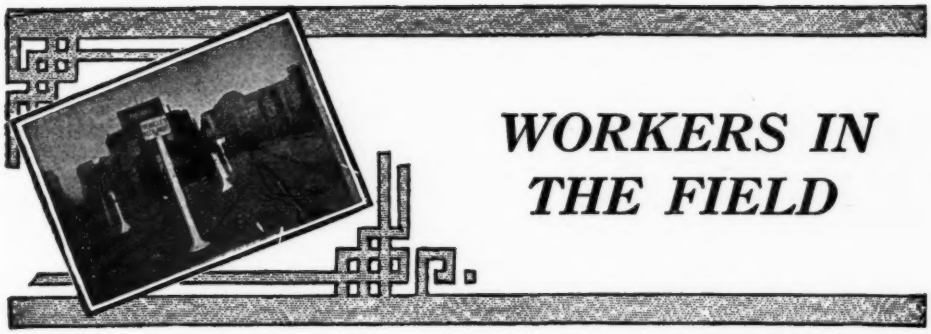
The following rates from the Indianapolis ordinance may be taken as typical.

Wagon or truck for hauling boilers, machinery, safes or stone and drawn by 4 or more horses, $20; by 2 horses, $15; for hauling logs, lumber, brick or ice, 2 horses, $8; 1 horse $5; 4-horse omnibus, $10; 2-horse, $8; 4-horse tallyho, $10; 2-horse, $8; 4-horse wagon not used as above, $8; 2-horse $5; 1-horse $3; 2-horse dray or truck, $5; 1-horse, $3; 2-horse furniture car, $7; 1-horse, $4; 2-horse sprinkling cart, $8; 1-horse, $5; 2-horse hack or hackney carriage, $6; 2-horse barouche, coupe, rockaway, trap, cab or surrey, $5; 1-horse family surrey, $2; horseless carriage, $3; 1-horse surrey or vehicle for delivery or hauling purposes other than above described. $3; 1-horse or pony driving cart, $2; push or hand cart, $2; bicycle, except for children under 14 years, $1; 1-horse vehicle not above mentioned, $3; 2-horse, $5; 3-horse, $6; 4-horse, $8.

Numbers are required and plates are described, and are furnished with the licenses.

Lights at night, widths of tires for iron and for wooden axles are prescribed.

Automobiles are not licensed because the state licenses them and prohibits licensing by cities.



WORKERS IN THE FIELD

Burned Asphalt Can Be Prevented

The Editor of MUNICIPAL ENGINEERING:

Sir—In the July issue of your journal, on page 49, is an article entitled "Burned Asphalt Cement Can Be Prevented." Inasmuch as this article does not bear the name of a contributor, we must presume that it is editorial, and as the inference to be drawn from it is that unless asphalt be melted by steam it will be burned, we ask permission to say a few words upon this subject. The use of steam as a melting agent for asphalt is not by any means a new idea; in fact, it is about as old as the asphalt paving industry itself, and has been experimented with both in paving plants and in refineries. Careful laboratory experiments have also been made along that line, the details of which will not be gone into here, but the results were such as to warrant doubt of the statement that steam at a boiler pressure of 125 pounds, not superheated, will raise the temperature of asphaltic cement to 350 degrees Fahr., unless some auxiliary or secondary means of assisting the steam heat be used in connection therewith.

Asphalt melting kettles have been superimposed over the settings of sand heaters in such manner that the surplus heat from the fires of the sand heaters acted upon the shells of the kettles from below and thus formed heating means auxiliary to steam melting coils arranged upon the insides of the kettles, but in a strict sense of the term this cannot be called steam melting; rather it ought to be termed combination melting, inasmuch as the heat comes from both the steam coils and from the fires below the kettles.

According to the tables relating to the properties of steam, found in Kent's Engineer's Hand Book, the Fahrenheit temperature of steam at a boiler pressure of 125.3 pounds is 352.8 degrees. Inasmuch as it is a well-known fact that a very considerable percentage of loss is occasioned between the boiler and the melting kettle, it is difficult to understand how you can obtain 350 degrees temperature in your asphaltic cement from steam at 125 pounds boiler pressure, and practically the same temperature. We would be glad of enlightenment upon this point.

Your article states that with steam at 125 pounds pressure your asphalt "cannot exceed 350 degrees," but the real question is this: Can you obtain 350 degrees of temperature from steam at 125 pounds pressure without outside assistance from another source of heat?

In this article you also make this direct statement: "All asphalt coming in contact with the part of a melting kettle nearest the fire is burned in spite of any agitation given it."

According to this statement, all of that vast amount of sheet asphalt pavement that has been laid in the past has been made from mixtures in which the asphaltic ingredients have been burned. Now, while it is true that an arrangement in which a melting kettle in an asphalt plant is set directly over the fires may be such that the contents of the kettle will burn, yet it is also true that the builders of the best types of modern plants do not follow that practice, but so separate the fires from the kettles by interposing walls that burning of the asphaltic material is practically impossible if the melting operations are under the charge of an ordinarily intelligent operative, and there is no more reason why the asphalt should be burned than there is that the water should be permitted to get too low in the boiler and the boiler explode.

There are certain advantages connected with steam melting which appeal to the designer of asphalt paving plants, the principal one being that if fireplaces are dispensed with more room will remain for melting capacity in the same amount of space; but also there are serious disadvantages, and the plant designer must exercise his judgment as to which method or process will produce the best results. The point should not be overlooked that whichever means of melting be employed, coal will be the original source of the heat, and it is an axiom in mechanical engineering that the more removes from the

coal pile the greater the loss of efficiency.

F. A. HETHERINGTON,
Indianapolis, Ind.

The article referred to was contributed and not an editorial expression, the editorial department being directly responsible only for material in the editorial department or otherwise bearing the statement that it is prepared under its direction. The attempt is made to admit to any part of the magazine only material which is based upon fact or which will throw light upon debatable questions, but there are great differences of opinion and even of observations of fact, and so the lines cannot be drawn too closely. The editorial department is always anxious to present all sides of any question on which there may be differences of opinion, and therefore welcomes both the original article and Mr. Hetherington's discussion of it.

A careful reading of the article in the July number will show that it was carefully written, so that it does not misstate facts. Mr. Hetherington's additions to the supply of facts are pertinent, however, and call attention to points which might be overlooked in a casual reading of the earlier article.

Septic Tank vs. Imhoff Tank.

The Editor of MUNICIPAL ENGINEERING:

Sir—In a letter published in your issue for June last, under the heading, "A Word for the Much Abused Septic Tank," attention is called to the many and varied reasons for so-called septic tank failures, and the statement is confidently made that "no septic tank which is properly designed with due regard to the character and volume of sewage to be treated, and in which the fundamental principles of the septic process are correctly applied, will fail to operate successfully and do all that can be reasonably claimed for it; and further, that such an installation is not only the most economical in first cost and operating expense, but the most efficient method of sewage disposal that is known today."

This is a broad statement, in view of the opinions we occasionally see expressed in the technical journals, that the septic tank does not accomplish what was originally claimed for it, but it is none the less true, and from the remarkable efficiency of plants that have been installed along correct lines in this and other countries, we can only infer that these disparaging remarks are but the logical result of unwise experiments with tanks in which the fundamental principles of the septic process have been ignored.

These unsatisfactory experments are so numerous, however, that in many localities the septic tank is positively condemned, and it is not surprising that many municipalities have been induced to adopt Imhoff tanks.

The Imhoff, or two-story septic tank, is very similar to its predecessor, the Travis or Hampton tank, and is distinguished therefrom only in an arrangement of baffles on which Dr. Imhoff has secured U. S. patent, and is demanding substantial royalties.

While insisting on a recognition of Cameron's septic process patent in connection with the Imhoff tank, the Cameron Company have freely admitted that there is no conflict between the two patents, inasmuch as the Imhoff patent covers merely the apparatus peculiar to the Imhoff type of two-story septic tank, whereas the Cameron patent covers the basis process, without infringing upon which the Imhoff tank cannot be used.

Dr. Imhoff has admitted that his patent in no sense covers the process involved in its operation, and has very frankly told the writer that prospective users of his device were so advised by the engineers who are exploiting the Imhoff tank.

The Imhoff tank, it may be explained, is simply another experimental adaptation of the septic process; it differs, however, from the single-story septic tank in that:

1. On account of its great depth it costs two or three times as much as a single-story tank of equal capacity.

2. The solid matter stored in the lower compartment of the Imhoff, or two-story tank, requires frequent removal, whereas in the single-story septic tank, when properly installed, the organic solids are completely liquified by undisturbed anaerobic action, and there are no excessive accumulations of partially disintegrated organic matter to be removed.

3. The Imhoff tank requires almost constant expert attention, whereas the single-story septic tank requires little or none.

As to their relative efficiency, it does not require a great amount of technical knowledge to determine the character of liquid effluent to be expected from the two types of tanks. The rest-period, or length of time the liquid sewage remains in each, is approximately as follows: Single-story tank, 16 to 24 hours; Imhoff, or two-story tank, 2 hours.

For a practical demonstration, fill two vessels with crude sewage, allow one to setlle for a period of two hours, the other for from 16 to 24 hours, decant the liquids, apply any reliable test and their relative clarity can be easily determined.

It has occasionally been claimed by advocates of the two-story tank, that the longer stay of liquids in the single-story tank is detrimental to the effluent by reason of its becoming 'septicized'; this is true only as a result either of improperly arranged inlets and outlets, the introduc-

tion of unnecessary baffles, or other defective design as was suggested in my former letter; these defects are the cause of the bad odors so often complained of, and which are entirely unnecessary in a properly designed single-story septic tank.

H. D. WYLLIE,
Chicago, Ill.

Individual Septic Tanks

The Editor of MUNICIPAL ENGINEERING:

Sir.—In your July number on page 35 I note an inquiry regarding individual septic tanks. Thru our St. Louis representatives, the Barks & Barstow Mfg. Co., we have on the market a small Cameron septic tank for individual residences, country homes, etc., which we believe to be superior to anything of the kind yet introduced; it is described in a pamphlet sent you herewith. H. D. WYLLIE,
Chicago, Ill.

The pamphlet describes the methods of applying the septic process in two stages, the first or liquefying stage proceeding in the septic tank and the second or aeration and filtration stage proceeding in an aerator and filter tank. It may also proceed without the aerator and filter tank by using a system of sub-irrigation and underdrainage, which is quite fully described. Specifications are also given for the construction of the septic tank, and the filter tank with its aerator, and for the valves and valve chamber, in case sub-irrigation is used.

Municipal Swimming Pools

The Editor of MUNICIPAL ENGINEERING:

Sir—For information of C., Decatur, Ga., whose inquiry is on p. 35 of the July number of MUNICIPAL ENGINEERING, enclosed find clipping from the Pittsburgh Sun of July 20, 1914, also photographs showing the boys in action in what we think the best and largest swimming pool in the United States.

We are going to have some photos taken next month showing our bath house and play grounds adjacent to swimming pool, and will be glad to send him one or any other information he may desire.

ARCHIE DUNCAN,
Superintendent of Parks and Public Property, McKeesport, Pa.

Following is the description of the pool referred to:

With a new fountain playing in its center and numerous improvements which make it one of the largest and finest swimming pools in the country, the great bathing basin of McKeesport, on the banks of the Youghiogheny River, is attracting thousands these hot midsummer days.

Meanwhile, in the newly laid out play ground at one side of the immense bath, hundreds of children disport themselves. Daily, from morning until after dark, men and boys, women and girls of the Tube City flock to the pool. Hundreds are in the water at one time, their heads bobbing over the surface. Daily, too, come other thousands to watch this sport in the water, from the tiers of benches which line two sides of the basin.

Bath houses, showers, diving boards and chutes add to the joy of the bathers, and are kept in constant use. Guards are continually on duty, and no bather has been drowned since the opening of the pool. Only a short distance away is the Youghiogheny River, neglected by the bathers who once splashed and swam in it.

Women take possession of the pool

Thursdays of each week. No men are permitted in the vicinity that day. The capacity of the place is taxed to its limit, guards say. More time soon will be demanded by the women of McKeesport, it is said, to enjoy the delights of the swimming pool.

Already this summer the average attendance per week is estimated at 5,000. The pool opened June 9, and for the remainder of that month 16,000 bathed in its waters. The average daily attendance is approximately 1,000. During women's day between 600 and 800 women attend. Sundays the general attendance is practically doubled, fully 2 000 people crowding the pool from the time it opens, at 8 o'clock in the morning, until its close at 9 o'clock in the evening.

Before the pool was established upon its present basis drownings in the Youghiogheny and Monongahela Rivers averaged twelve each season. No drownings have been reported in recent years, owing, it is believed, to the fact that the rivers have been deserted for the pool by bathers.

It is estimated that more than 700 persons are taught to swim annually in the basin. Three men are on duty continually as guards and swimming instructors, and one woman. On Thursdays two women instructors are employed.

In a recent investigation, studying such institutions, conducted by the University of Wisconsin, McKeesport received high praise for its pool, which was pronounced unequaled, of its kind, in the country.

Archie Duncan, member of the city commission of McKeesport, and head of the department of parks and public properties, has made the big pool his especial charge. Thru him were made most of the improvements that have been added in the last year and in previous years. Thru his solicitation, the National Tube Company placed the greater part of the apparatus in the pool, including the chutes, swings, carrousels, bath houses and cold showers. In all, it is estimated that the company has expended approximately $17,000 upon the pool. The cost to the city has been chiefly maintenance.

The bathing basin was installed five years ago. Since then it has been enlarged. Now its concrete lining covers a space of 234 by 260 feet. It has been graded carefully, so that there is a section in which children can paddle about without danger. In another section high diving may be done with safety. The depth of water varies from six inches in the east end to nine feet in the west end. Water for the pool is pumped from the Youghiogheny River after being filtered.

William H. Coleman, present clerk of courts, is credited with having taken the first definite step in the development of the pool. That was during his term as mayor of McKeesport, which ended in April, 1909. At that time excavations had been made and at the close of his term Mr. Coleman donated $500 of his salary to pay for cementing the bottom.

Last year more than 50,000 bathers enjoyed the benefits of the pool, it is estimated. That this number will be exceeded materially before the close of the present season is believed by the McKeesport authorities.

The Editor of MUNICIPAL ENGINEERING:

Sir—Denver has had a municipal bath house with a swimming pool for several years. It also has swimming pools in three or more of the lakes in city parks and is considering the placing of one or more in addition in other lakes. There was a swimming contest in the lake at Washington Park on the Fourth of July.

Besides the swimming pools there are also wading pools in the Sunken Gardens, Cheesman Park and others, which are for the little ones too young to swim.

W. A. PECK. C. E.,
Denver, Colo.

P. H. Weathers, architect, Oklahoma City, Okla., calls attention to the municipal baths at Guthrie, Okla., a very modern institution, which doubtless includes a swimming pool, probably not open like those in the cities named in the answer to "C" and in the communication above.

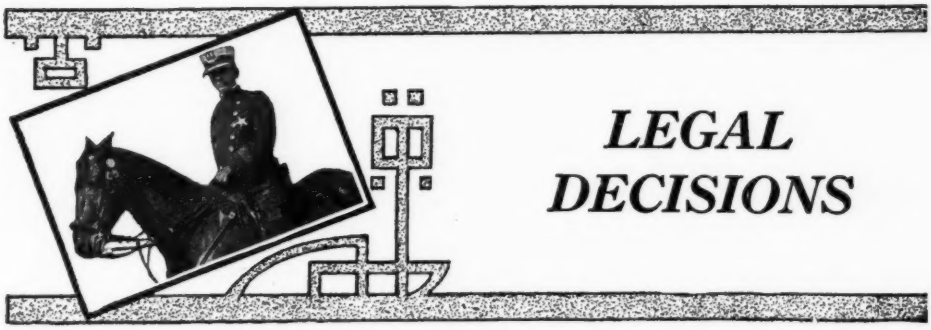
The latest number of *Public Affairs*, the bulletin of the Civic League of St. Louis, Mo., contains a photograph of Fairground Pool, which is also said to be the largest artificial out-of-door swimming pool in the world. It is the only public swimming pool in St. Louis, and opened its second season on June 12. It holds almost 4 000,000 gallons of water and accommodates 2,500 bathers at one time.

Ordinance Prohibiting Free Lunch With Sale of Liquors

The Editor of MUNICIPAL ENGINEERING:

Sir—I see in your July issue, p. 34, the request to have some of your readers inform you if any ordinance prohibiting free lunch with the sale of liquor has been put to test. It may therefore interest you to know that the city of St. Paul, Minn., has had such a law enforced for many years.

P. H. HANSEN,
Chicago, Ill.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Tenat Must Pay Water Rent—Ordinance to Contrary Unjust—An ordinance enacted by a city, authorized to furnish water to its inhabitants, requiring all assessments for unmetered water consumers to be assessed against the owners of the property, instead of the consumers, is unjust, unreasonable, and an arbitrary distinction between the inhabitants, so as to be void; another by-law, which required all unmetered assessments to be paid in advance. furnishing all necessary protection to the city. At common law a landlord is under no obligation to furnish water to his tenant; nor is a tenant bound to pay water rent, in the absence of agreement. Farmer v. Mayor, et al. of Nashville (Tenn.) 156 S. W., 189.

City Must Provide Outlet for Surface Water in Improving Street—A municipal corporation has the right to improve and provide for the drainage of its streets; but, if in so doing it causes an increased flow of surface water upon or against private property, and negligently fails to provide a sufficient outlet for the escape of the water thus brought upon or against such property, it will be liable to the owner thereof for any damage that may result from such negligence. Naysmith v. City of Auburn (Neb.), 146 N. W., 971.

City Liable for Damage from Breaking of Water Tank or Reservoir—A city is liable for injury caused by the breaking of its tank or reservoir in which it has collected water in large quantity to supply its waterworks system. In the absence of proof that the breaking of the tank was caused by some superior force, such as an unusual and violent disturbance of the elements or an explosion clandestinely caused, negligence will be inferred from the breaking. Restriction upon a city by its charter in the rate of water rent which it may lawfully charge consumers does not affect the question of its liability. Three cases: Wigal, Wigal, and Jackson v. City of Parkersburg, (W. Va.), 81 S. E. pp. 554, 558, 559.

City May Provide for Future Private Lighting—Tax Rate Limit and Bond Interest.—A city, authorized by statute to construct an electric lighting system and issue bonds therefor, may provide for the construction of a public lighting system in such a way that private lighting may be subsequently added, tho the plant so constructed may be more expensive than one constructed solely for public lighting. The mere fact that the interest on bonds issued for a public lighting system and the costs of maintenance will so swell the city tax rate as to exceed the tax limit does not alone show that the tax limit will be exceeded, since a sufficient saving may be effected by the system and thereby offset the increase. Livermore v. Mayor, etc., of City of Nullville, et al. (N. J.), 90 Atl. 380.

Liability of Water Company for Fire Loss.—In an action against the proprietor of a water plant, evidence held to show that when it's agent told a consumer that he would be furnished water for all purposes, neither party contemplated the furnishing of water for fire protection, and hence it was not liable for its failure to furnish water for such purpose; it appearing that the city government had assumed the burden of fire protection. An individual or company authorized to do so may so contract as to incur a liability for damages proximately resulting from a failure to furnish water sufficient to extinguish fires. Dublin Electric and Gas Co. v. Thompson, (Tex.), 166 S. W. 113.

Liability for Injury on Sidewalk Constructed on an embankment. The fact that a sidewalk was constructed upon an embankment 2 feet high, with a gentle slope of 3½ feet to the bottom thereof, nor that the walk was about 4 inches above the level of the top of the embankment, make the place a dangerous one, so as to require the erection of barriers by the town for the protection of persons using the walk. The construction of a sidewalk with its edge about

four inches above the surface of the ground at the side of the walk does not render the walk unsafe for travel, so as to make the town liable for injuries received by one who stepped off the walk. Town of Elsmere (Ky.) v. Tanner, 166 S. W., 220.

Liability for Injury on Part of Street not Improved.—Where a strip in the center of a platted street had been cut down to the established grade, leaving the remainder thereof about six feet above the grade, the city extended no invitation to the public to use that portion which had not been graded, and therefore was not liable for injuries received by one who was coming down a path from the top of the bank to the graded portion of the street. Robinson v. Kansas City, et al. (Mo.), 166 S. W. 343.

Validity of St. Louis Method of Assessing Cost of Street Improvement Affirmed. —St. Louis Charter, art. 6, § 14, requiring the assessment of one-fourth of the whole cost of improving streets on the property fronting on the improvement, in proportion to frontage, and that the remaining three-fourths shall be assessed on all the property in the district bounded by drawing a line midway between the street to be improved and the next parallel or converging street, and providing that if the property is divided into lots, the district line shall be drawn so as to include the entire depth of the lots fronting on the street, while causing an inequality of assessment where part of the property is laid out into lots and part is unplatted property extending a long distance over to another street, is not invalid as working a deprivation of property without due process, contrary to federal Constitution, amendment 14. Loth et al. v. City of St. Louis et al. (Mo.), 165 S. W. 1023.

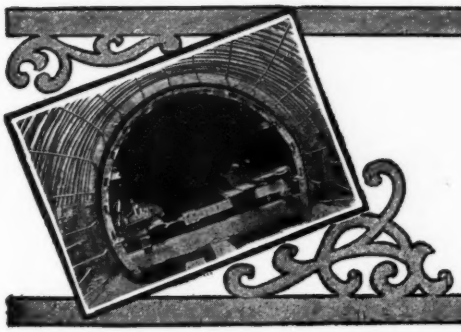
Liability for Damage to Property by Sewer Excavation.—The failure of a sewer contractor to notify a property owner of his intention to excavate near and below the level of the foundation of the owner's building was actionable negligence, if injury resulted from such excavation. A contractor, suing to recover from a city one-half of a judgment against the contractor and a city, which the contractor was compelled to pay, for injuries to property abutting on an alley by the contractor's omission to give notice to the owner of intention to excavate, cannot escape liability on the ground that there was a discrepancy between the actual width of the alley and that given to it in the specifications, since unless the contract covered the excavation causing the injury, the contractor had no authority to make it, and hence the contractor cannot recover herein. Wanger et al. v. Marr et al. (Mo.), 165 S. W., 1032.

City Can Build Competing Water Works.—The property of a private waterworks company is not taken contrary to U. S. Const., 14th Amend., by the municipal construction of a competing plant, where there is no contract immunity from such competition, altho the water works company may be forbidden by the local law to divert its property to other uses, and will be called upon to pay taxes to help its rival to succeed. Madera Water Works v. City of Madera (Cal.), 33 Sup. Ct. 571.

Changes in Plans for Sewer After Letting do not Vitiate Contract.—Material changes in the construction of a district sewer in a city, made after the letting of the contract, by shortening one of the ditches called for and by adding laterals at places not called for, necessary to proper drainage for the entire district, were proper in view of the duty of the city to construct the sewer so as to properly accommodate the property owners of the district, and did not affect the validity of the special tax bills, especially as the contract provided for changes in the work with proportionate alteration in the price. Changes in the grade of the main pipe of a district sewer in a city lessening the cost of the work without impairing the service to be rendered do not vitiate the contract or the special tax bills. Stover et al. v. City of Springfield, Mo., 152 S. W., 122.

Sewer Assessment Liability on Owner at Time Sewer was Ordered—An assessment of benefits for the construction of a sewer is a lien on the land covered by it, which dates back to the time of the order for the construction of the sewer and is an incumbrance from that time. The court, on certiorari to quash a sewer assessment levied nearly seventeen years after the building of the sewer, will not grant relief on the ground of delay, where it does not appear that the petitioner has suffered thereby. Hester v. Thompson, tax collector, et al., (Mass.) 105 N. E., 631.

Eminent Domain Power Transferable to Agents—The Legislature has, by necessary implication from its various acts giving to municipalities a right to obtain a water supply, granted to them the state's right in so much water to be taken from the streams of the state as they may need for their lawful purposes. Municipalities having the right by implied grant from the state to appropriate water from streams for their lawful uses and purposes can contract with water companies to supply such water, and thus make them their agents or instrumentalities for that purposes. Under Act 1888, authorizing municipalities to contract with water companies to supply them with water, a water company with whom a municipality has so contracted may delegate its agency or contract to another. Wilson, Atty. Gen. v. East Jersey Water Co., (N. J.) 90 Atl., 728.



SANITATION

Borax Will Prevent Breeding of Flies

As a result of experiments, the specialists of the Department of Agriculture have discovered that a small amount of ordinary borax sprinkled daily on manure, will effectively prevent the breeding of the typhoid or house fly. Similarly, the same substance applied to garbage, refuse, open toilets, damp floors and crevices in stables, cellars or markets, will prevent fly eggs from hatching. Borax will not kill the adult fly nor prevent it from laying eggs, but its thoro use will prevent any further breeding. While the "Swat the fly campaign," traps and other devices for reducing the number of typhoid-carrying flies are of value, they are of less importance than the prevention of the breeding.

The investigators found that 0.62 of a pound of borax, or 0.75 of a pound of calcined colemanite (crude calcium borate) would kill the maggots and prevent practically all of the flies ordinarily breeding in eight bushels of horse manure from developing.

In the case of garbage cans or refuse piles 2 ounces of borax or calcined colemanite, costing from 5 cents a pound upward, according to the quantity which is purchased, will effectually prevent flies from breeding.

Borax is not a very poisonous substance and the feeding of garbage that contains it to hogs, is not likely to be a serious matter, but borax in large quantities does produce gastric disturbances and for this reason a certain amount of care is advisable.

The method for using this substance in the case of stables, is to sprinkle the borax or colemanite in the quantities given above, by means of a flour sifter or other fine sieve, around the outer edges of the pile of horse manure. The manure should then be sprinkled immediately with two or three gallons of water to eight bushels of manure. It is essential, however, to sprinkle a little of the borax on the manure as it is added daily to the pile, instead of waiting until a full pile is obtained, because this will prevent the eggs which the flies lay on fresh manure from hatching. As the fly maggots congregate at the outer edge of the manure pile, most of the borax should be sprinkled there.

It is estimated that it would cost only one cent per horse per day to prevent all breeding of flies in city stables. If calcined colemanite is purchased in large shipments, this cost should be considerably less. At the same time, its value for use in the garden or for sale to farmers will not be lessened.

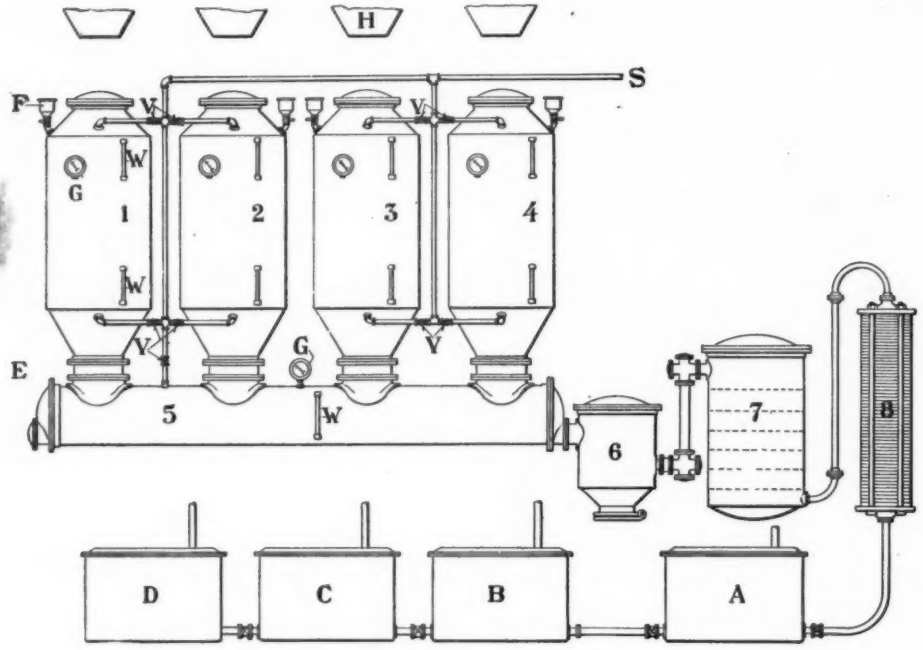
The details of the experiments with borax and other larvacides will be found in U. S. Department of Agriculture Bulletin No. 118.

Garbage Disposal By the Hirsh Chemical System

Sixty thousand tons of garbage were treated by the Hirsch chemical process in the last nine months by the city of Chicago in the temporary plant. They used five wooden tanks without covers. The chemicals completely and promptly deodorized the garbage, rendering decay and odor impossible for all time to come.

The apparatus for treating garbage and other waste material by the Hirsh chemical process, converting them into useful products, in an absolutely odorless manner, consists chiefly in tanks. One tank will completely deodorize and treat its contents within one hour, which includes filling and discharging, as against the old process of rendering for nine hours or more and creating more disagreeable odors at the expense of a great deal of fuel and loss of quality and quantity of fats. A tank of a capacity of five tons will treat fifty tons in ten hours, or 100 tons in twenty-four hours.

For large cities with receiving stations in different parts of the city this system is ideal. The many receiving stations shorten the distance of hauling the garbage, reducing the cost of hauling. But, unless the garbage is completely deodorized and kept deodorized, the nuisance created by the same would be multiplied with the receiving stations. To avoid this a tank



should form the equipment of each receiving station. Samples of garbage treated with the Hirsh chemicals one year and some five years old are as fresh today as on the day they were treated, having only the fresh, aromatic, pleasant odor of the fruit or vegetable constituting the garbage, while meat, fat, bones remain absolutely odorless. This aromatic, pleasant odor of the fresh fruit or vegetables does not spread beyond the tank containing it, and requires a close application of one's nose to notice it. If the Hirsh chemicals are applied to the householder's garbage can or to the wagons carting the garbage, the proverbial ounce of prevention will keep flies at a distance, as they never approach garbage treated in this manner, nor is decay or putrefaction then possible. Such garbage can be hauled thru the streets with as little offense as a load of lumber, iron or apples. Wherever the Hirsh system is introduced, these chemicals will be furnished for wagons and private garbage cans, so it will not then be a question of deodorizing garbage or disposing of bad odors, but only a question of converting the garbage, street sweepings and manure into products more valuable than any ever produced or thought of before. The Hirsh process is the first and only one treating garbage and other waste products chemically for the purpose of deodorization and utilization.

In the drawings annexed H are hoppers, to receive the garbage, which may pass into the tanks 1, 2, 3, 4 if all of them are used for the conversion of garbage. These are designed to hold ten tons and would convert forty tons per hour. Either one of them can be used for conversion alone and independently of the others, all of them forming a system of separating the by-products from the garbage and from each other.

The garbage being placed in tank 1 and treated, the fats and glycerine will collect in tank 2, while dextrin, dextrose, phosphates and some other products remain in tank 1. After conversion and separation, the contents are dropped into tank 5, whence they are forced into tank 6, the inner arrangement in which separates bones and undissolved metal from pulp and liquid. The two last named substances are further separated in tank 7, then forced thru the press 8, which retains all solid matter, while the liquid discharges into tanks A, B, C, D. The press is so arranged that it automatically discharges the pressed cakes of solid matter, while in the tanks A, B, C, D some of the metallic salts are crystallized the tin separated in the metallic state chemically pure without any smelting, leaving in solution dextrin, dextrose, ammonia salts, which are readily separated from each other. The ammonia salts bring the full price they would in the form of fertilizer, while the vegetable portion of what would be fertilizer is converted into dextrin and dextrose, bringing a much higher price.

During the entire operation, the garbage is not exposed to the air. The metal-

lic salts require water for crystallization, dextrin and dextrose require water to keep them in solution. In this way the water is disposed of and utilized and all expense of drying, both for fuel and machinery, is saved. W shows the water glass, indicating the height of liquid in the tank. G is the pressure gage. V are the valves. F is a funnel with pipe connection for introduction of chemicals. S is the steam pipe. Tanks A, B, C, D are connected with each other and can be used jointly or separately. They are provided with pipes for the escape of gases that are utilized.

Where cities do not attempt utilization, but desire only sanitary disposal of garbage, one tank is sufficient, and where, in receiving stations, a tank is added to the equipment, the receiving station may be a conversion station at the same time and save all subsequent handling. Bulky iron waste, like bedsprings, bedsteads, etc., may be thrown into tanks, converted into salts and bring more than double the value they would have as scrap iron, the only handling needed being throwing them into the tanks, which is less than the handling of bulky scrap iron as such.

Plumbing Regulations in New Orleans

The supervisor of plumbing under the Sewage and Water Board of New Orleans, La., in his last annual report describes his duties as follows:

The organization of the plumbing department at the present time consists of the supervisor of plumbing, assistant supervisor of plumbing, first clerk in charge of the records and clerical work of the department, ten plumbing inspectors, whose duties are to inspect the sanitary plumbing from the beginning until the completion and acceptance of the work, and seven plumbing inspectors whose duties consist in making the tie-in or connection direct from the house sewer, with the sewer connection brought up from the sewer in the street to the property line; a receiving and general information clerk, two stenographers, and two men engaged in clerical and inspection work, obtaining data necessary to the serving of notices in connection with the 90-day resolution, complete the force.

Before any plumbing work at all is done it is necessary that a licensed master plumber file a plan showing the character of plumbing that is to be done in the premises in question (signed by the property owner, authorizing the work to be done), said plan showing the size of pipe, kind of traps to be used, and the various methods of venting. Upon examination, should this plan be found to be in conformity with the rules, it is approved by the supervisor of plumbing, or his assistant, and permits granted to the plumber, one to do the work, and the other to permit the premises to be connected to the sewer after said work has been inspected and satisfactorily completed in accordance with the rules.

Four inspections are generally required for every job before it is declared satisfactory in its entirety. The tests consist of a ball test, a house connection or tie-in test, and a water and peppermint test.

The ball test is an inspection and test of the underground terra cotta pipe which runs from the property-line back, receiving the discharge from the plumbing fixtures in the building and conveying same to the public sewer in the street.

The inspector sees that the pipe is laid at a grade of not less than one-quarter of an inch to the foot, and that the joints are properly made, calked and cemented, and that the proper covering is maintained in accordance with the plumbing rules. The line is then tested by sending a wooden ball, one-half inch less in diameter than the diameter of the pipe, thru it, from end to end.

The house connection inspection is made where the public and house sewer are joined together at or near the property line. This inspection consists of seeing that the proper fittings are used, clean-outs brought up, so as to enable the proper cleaning out of the line in the event of stoppage, and the proper concreting of the whole.

The water test is made after the plumbing work inside of the building has been "roughed-in." The stacks are filled with water and allowed to remain in that condition for some hours. The inspector then examines the joints closely, and if they are improperly calked, leaks will appear at these joints. At the time of this inspection it is the duty of the inspector to examine the kind of pipe used, i. e., whether standard or extra heavy (for in some instances only the latter can be used), the depth of hubs, the size of pipe, the proper use of vents, and, in fact, to see that in every particular the work conforms to the rules of the board and is sanitary in every respect. This is the severest test put on the work, for, having passed this test, the only thing necessary to be done is the setting of the fixtures.

The fixtures having been set, the work is then subjected to what is known as the peppermint test. This test consists of pouring into the clean-out a mixture of hot water and oil of peppermint. The fumes that arise from this mixture are so pungent that if the work is not absolutely tight the odor of peppermint will be immediately detected in the premises. The inspector then tries out all the fixtures for the purpose of ascertaining whether

or not they are in good working order. At the time of this inspection all vaults and cesspools must be excavated, cleaned and filled, and the work as a whole must be in a completed condition.

It is only after these tests and inspections have been made that what is known as a final certificate is issued. This certificate is to the effect that the plumbing has been inspected and tested, and found in substantial accord with the plumbing rules and regulations.

Up to the first day of November, 1908, this department not only received all applications for sewer and water connections, but attended to the installation of same. From that date up to May 1, 1913, these applications from the public for sewer and water connections were still received and passed upon by this department, but the installation of the work was not supervised by this department. From that date, however, these applications also have been received in the sewer and water connection departments, and while some conditions necessitate this department at various times being consulted on these applications—and in this respect I particularly refer to the sewer connection application—this branch of the work is almost in its entirety handled by the above respective departments.

There are at present 169 licensed master plumbers doing business in the city of New Orleans, in connection with the plumbing department. In order for a plumber to obtain a master plumber's license he has to be at least twenty-one years of age and pass a satisfactory examination, both practical and technical, as to his ability to do the work. Applicants are provided with application blanks setting forth the name and residence of the applicant, the number of years in the plumbing business, the name of the last employer, and references as to the ability and reliability of said applicant; also the name of the bondsman or bonding company which will sign the required bond; also a promise that said applicant will pay the fees of said board, before he will be permitted to stand the examination.

As to a firm or corporation wishing to do business as such, they have to file with the Sewerage and Water Board a statement showing the composition of said firm; or, if a corporation, a copy of its charter, and shall have at least one member or officer of said firm or corporation qualify as a licensed master plumber.

The examinations are conducted by the supervisor of plumbing and are written, or oral, or both, technical and practical, sufficient to determine an applicant's ability to draw proper plans for plumbing work and show knowledge of the theory and practice of plumbing in general and of the plumbing regulations of the city of New Orleans.

In reference to master plumbers and these examinations, the above gives some idea as to what is necessary, everything in connection therewith being more in detail in the rules of the Sewerage and Water Board governing use of sewerage, water and drainage systems, and plumbing, from which rules this is taken.

The plumbing department has been in operation since October, 1906, at which time it was organized with Mr. J. L. Porter as supervisor, who remained as such until 1908, when he was transferred to the position of director of the water purification plant, and the present incumbent assumed charge of this department.

Previous to the installation of the sewerage system in this city and organizing of the plumbing department there were very few set rules concerning the installation of sanitary plumbing, everything at that time being connected to cesspools or vaults, which were required by law to be cleaned at certain intervals.

The work in general has progressed smoothly, and there has been very little complaint concerning the sanitary plumbing, the stoppage of pipes, etc., and what defects have arisen were such that they were rectified with little trouble or expense.

Illinois Good Roads Law Valid

The Supreme Court of Illinois in the case of Jacob Martens of McLean county, Ill. v. the State Auditor and State Treasurer to restrain them from paying out money for state aid roads has decided in favor of the Tice law, thus attacked, which provides for state aid for road building to counties under certain conditions.

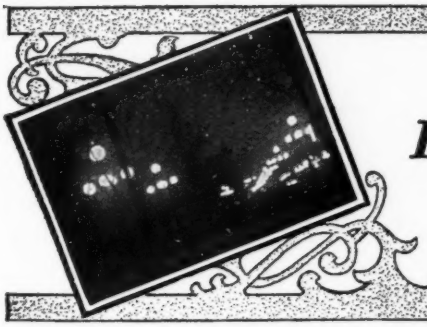
What the Snow Cost

It cost New York City $2,440,000 to clean the streets of snow last winter.

Bridge Specifications of the Illinois State Highway Department

The Illinois State Highway Department has issued standard contract form and general specifications for bridge work, which must be used on all bridge work requiring the approval of the state highway commission or a county superintendent of highways, contracted for of placed under construction after July 12, 1915.

Proposal forms accompany the specifications, one set to be used in letting contract for a single concrete bridge, one for a single steel bridge and one for several concrete bridges to be let in one contract.



FIRE AND WATER

Shingle Roofs Spread the Salem Fire

Massachusetts is still bending a thoughtful brow over the ruins of Salem.

Everybody agrees that the one thing which contributed most to the spread of the fire was shingles. House after house burst into flame when the rain of sparks touched the tinder-like shingle roofs. A dry, weathered shingle makes about the finest kindling known. In a closely populated town, a brisk wind carries flames over shingle roofs as fire sweeps over sunburnt prairie grass.

The Bay State is using the Salem fire to start a strong argument against shingles. It will do the rest of the country no harm to listen.

It is significant that two of the few buildings that were absolutely unaffected and which were in the midst of the Salem fire, subjected to falling sparks and burning embers, were covered with asbestos roofing.

New Water Supply for Greater Winnipeg

THE "Greater Winnipeg Water District" consists of the City of Winnipeg and surrounding municipalities. Appointed by the administration board to have charge of this work are: Mr. S. H. Reynolds, chairman of commissioners; Mr. James H. Fuertes, consulting engineer, and Mr. W. G. Chase, chief engineer.

A fine quality of water from Shoal Lake will be brought to the city of Winnipeg by means of a gravity line ninety-five miles in length.

A concrete aqueduct will carry the water from the intake, which is located on Indian Bay, a branch of Shoal Lake, to a reservoir (250,000,000 gallons capacity), which is to be constructed at Deacon, about ten miles from Winnipeg. The capacity of this portion of the line will be 85,000,000 gallons per day. The total cost of the entire project will be $13,000,000.

From the reservoir a 5-foot steel pipe will be laid to the east side of the Red River crossing, a distance of about eight miles. From this point to the distributing reservoir at McPhillips street will be a 4-foot cast iron pipe; there will be several heavily reinforced depressed 8-foot circular sections at the river crossings along the line, while at the Red River crossing in Winnipeg a 5-foot cast iron pipe will be laid, imbedded in concrete, in a tunnel.

From the intake west, for a distance of eleven miles, a rectangular reinforced concrete section will be used. The size of this section will be approximately 11½ feet by 7¼ feet, and the remainder of the aqueduct will be the various sizes of an arch section of plain concrete. The sizes will vary, according to the different slopes, from 9 feet by 10 feet to 5½ feet by 6 feet; the average slope is 0.69 foot per 1,000 feet, while the heaviest is 1.54 feet per 1,000.

Along the line of the aqueduct there will be Venturi meters, waste weirs and blow-offs.

The aqueduct section of the work will require approximately 3,074,000 cubic yards of excavation, 2,300,000 cubic yards of back-fill, 375 000 cubic yards of concrete and 13,000,000 feet B. M. timber for platforms and drainage.

The intake is situated on Indian Bay, near the mouth of the Falcon river, a stream of brackish water. In order to prevent this water from contaminating the waters of the lake near the intake, the course of this river will be changed by means of a dyke and channel. This will force the Falcon river water into another section of the lake away from the intake.

The dyke will be 7,300 feet long, with a maximum height of about 29 feet; maximum width, 130 feet, and will require approximately 233,000 cubic yards of sand and gravel filling and 17,000 cubic yards of rock rip-rap. The diversion canal will be about 3,500 feet long, with a 30-foot width at bottom, and requiring an excavation of about 40,000 cubic yards of earth.

In order to carry on this undertaking, which is in a very rough and unsettled

country, it is necessary to construct a standard-gage railway for the transportation of materials and supplies, and also a telephone line. This railway will be laid with 60-pound steel, and will require 1,000,000 yards of excavation for embankment, 200,000 yards of ballast and 10,600 gross tons of rail.

The right of way will be from 300 to 500 feet wide, thus giving plenty of room for the aqueduct and the railway, with the contractors' working tracks between.

The district will operate the railway and supply the contractors with all sand, gravel and cement for the aqueduct. The sand and gravel necessary for the construction of the aqueduct will be obtained near the right of way from two pits approximately a quarter of the distance from each end of the work. These pits will be operated by the district and will be equipped each with a steam shovel, dinky locomotives and dump cars. Hopper bins of about 2,000 yards' capacity will be installed in the pits, with the necessary screening apparatus for screening the gravel into the proper sizes necessary for the work.

The aqueduct work will be divided into six contracts, and it is expected that five years will be necessary to complete the aqueduct, the first year of which will be entirely devoted to the construction of the railway.

In 1915 actual work on the construction of the aqueduct will commence and will continue thruout the four following seasons. Five location parties were in the field from October, 1913, to March, 1914, making the necessary surveys for the location of the aqueduct. In March engineering construction parties were put into the field and clearing and grading was commenced on the right of way.

The Northern Construction Company, of Winnipeg, have the contract for the grading of the entire railway line, and expect to have it completed and ready for operation by January 1, 1915.

Comparison of Centrifugal and Reciprocating Pumps

The following comparison of the economies of large reciprocating pumps and centrifugal pumps was made in connection with the design of new pumping units for the Chain of Rocks pumping station of the St. Louis water works. It presents in brief the reasons for the present popularity of the steam turbine and multi-stage centrifugal pump. L. A. Day included it in a recent paper presented to the St. Louis Engineers' Club.

In considering relative values, not only first costs but operative, maintenance and interest charges as well must be taken into account. Progress in the design of centrifugal pumping units has reached a point where serious doubt is created as to the wisdom of invariably installing enormous piston pumping engines, for in installing large pumping engines entailing a considerable expenditure, it seems wise to consider not only the possible life of the machinery, but its probable duration in view of present developments. It is true that the high duty steam pumping engines, with capacities for pumping large quantities of water, are superior to turbine driven centrifugal pumps in economy. However, a careful comparison between the two types of pumping units led us to choose the turbine driven type of pump.

Two 40,000,000-gallon reciprocating pumps for this service would have cost approximately $230,000, or $115,000 each. The duty in foot-pounds of work per thousand pounds of steam of the reciprocating type of pump would have been approximately 150,000,000. Two 40,000,000-gallon turbine driven centrifugal pumps cost $55,000, or $27,500 each, with an average duty of 94,000,000. The average maintenance costs of reciprocating units, according to station records as kept on the Allis-Chalmers 30,000,000-gallon pumps, is $780 each per year. It is safe to assume a maintenance cost not exceeding 2 per cent. of cost of turbine pumps per year, or $550 each per year. The operating charges are considered the same for each type of pump.

In capitalizing the investment the following formula was derived:

$$\frac{A \times W \times H \times P}{D} + F(i+d) + L + M = C;$$

in which

A = Total number of gallons pumped per year.

W = Weight of a gallon of water.

H = Average total head of feet pumped against.

P = Cost of steam per 1,000 pounds (13.4 cents).

D = Average duty in foot-pounds per 1,000 pounds of steam.

F = Total investment.

i = Rate of interest on investment.

d = Rate of depreciation.

L = Yearly cost of operating labor.

M = Yearly cost of miscellaneous expenses of operation.

C = Total cost per year.

Solving for C with both types of pumps we obtained a difference of $13.000 per year in favor of the turbine driven pump, which means that in a little more than four years the centrifugal pumps will have paid for themselves. tI is proposed to install a third turbine driven pump of 40,000,000 or 50,000,000-gallon capacity in this station in the next two years, in

order to bring the safe working capacity up to 150,000,000 gallons per day, and if reciprocating pumps were necessary, it would necessitate the erection of an additional building owing to the space they require. Needle ice suspended in the river water during the winter months and sand thruout the year are additional important reasons for installing centrifugal pumps at this station, as this type of pump is admirably adapted to handle water under these conditions with practically no trouble.

Calcium Hypochlorite as a Water Disinfectant

By E. J. Tully, Chemist, State Hygiene Laboratory, University of Wisconsin, Madison, Wis.

In a study of the effects of calcium hypochlorite upon water when used as a disinfectant the author experimented upon the clear public well water supply of Madison, Wis., the waters of Lakes Mendota, Michigan, and Winnebago, with varying degrees of turbidity and pollution. He also tested the amount of hypochlorite which would leave a taste or an odor in the clear city water and in Lake Mendota water, using the testimony of several persons on various samples after various periods had elapsed, 1 to 48 hours after treatment. The summary and the conclusions he draws from these experiments, as given in the *American Journal of Health*, are as follows:

Chemical disinfection offers a means whereby a very satisfactory purification of a water may be accomplished. Comparisons on a cost basis of the methods of chemical disinfection mentioned make it apparent that calcium hypochlorite is the most satisfactory and efficient agent at the present time for water disinfection.

The amount of organic matter in the water practically determines the quantity of calcium hypochlorite that it is necessary to use. As a general rule, practical sterilization may be accomplished by the application of from 0.1 to 1 part per million of available chlorin, but occasionally concentrations of 2 and 3 parts per million of available chlorin are necessary to effect desirable results with rather highly colored and turbid waters.

The removal of B. coli and intestinal organisms is usually more complete than that of the total organisms. Under the conditions of the laboratory experiments, the results of hypochlorite disinfection on typhoid organisms and intestinal bacteria in the various waters were practically identical. It is, therefore, safe to assume that the viability of pathogenic bacteria under working conditions in practical water disinfection is no greater than that of the typhoid organism, or intestinal bacteria as a whole. Consequently, the disinfection effected by calcium hypochlorite relative to the total bacterial removal may be referred directly to pathogenic bacteria with assurance of reasonable accuracy.

The slight odor and taste of chlorin imparted with somewhat more than 0.5 part per million is applied disappears in a short time, leaving the water entirely acceptable from a sanitary standpoint, and, as the hardness is not materially increased by the application of the usual small quantities employed, the treated water is not rendered unsuitable for industrial purposes.

There is no apparent reason for believing that the results are not of general applicability. The reactions involved are particularly free from interference on the part of the mineral constituents of normal waters; and normal variations of temperature have practically no effect on the final results. The efficiency of the process is also entirely independent of the secondary or after growth of harmless resistant organisms.

The calcium hypochlorite process of sterilizing water combines the desirable qualities of economy and efficiency, and affords cities and towns, which are unable financially to build a filtration plant, but are forced for sanitary reasons to adopt some method of purification, a means of insuring a safe water supply. It may be used to advantage in cases of emergency, where either filtered or unfiltered supplies have become infected and where it is difficult to cease using such supplies. Where mechanical filtration is not sufficient to render a water safe, treatment with calcium hypochlorite offers an excellent method of sterilization and is especially applicable in such cases.

Regulating Growth of Organic Matter in Reservoirs

In a paper before the Franklin Institute, Prof. W. P. Mason gives some suggestions as to the care of reservoirs with reference to preventing the growth of low forms of plant and animal life and improving water in which such growths have been permitted, which are abstracted as follows:

When meadow lands are flooded, the extraction of food for plankton growth must of necessity take place, and we are forced to choose between stripping the proposed bottom or else depending upon the employment of some means of killing or removing the organisms that are likely to develop.

As to what could be done to rid a water of the odors due to algal and other growths, the outlook was not very hope-

ful previous to the appearance of the "copper sulphate process" proposed by Moore and Kellernan in 1904 (Bulletins 64 and 76, U. S. Bureau of Plant Industry).

The method of applying this chemical is simple enough, and its use is very efficacious. Bought in bulk, it can be had at about 5 cents per pound, and its distribution is readily secured by filling it into perforated buckets, or even bags, and towing the same by rowboat or launch over the reservoir surface.

It must be remembered that it is not added to the water continually, but is used only at stated and widely-separated intervals, namely, at those times when the "crop" of minute organisms has become so well grown as to produce objectionable effect upon the water.

Perhaps one reason why the "coppering" of reservoirs has led to so much criticism is because of the dead fish that are to be seen after the chemical has been applied. When considering this effect upon fish life, one should bear in mind that the "dose" has of necessity to be applied uniformly over the surface of the water, and each acre of such surface presumably receives the same amount, irrespective of the depth of water that the acre covers. As a result, the shallow parts of the lake receive temporarily a greater quantity of the sulphate, per cubic foot of water, than do those which are deeper; again, the entire quantity of chemical intended for the whole body of the lake is delivered to a few inches of its surface layer; therefore, until diffusion has taken place, fish which chance to swim into such water receive a very concentrated dose and are likely to be affected by it. Distribution is complete by the time the water reaches the public mains, and, moreover, the minute dose used has been more or less completely disposed of thru its action upon the organisms for whose destruction it has been employed.

In a paper before the section on hygiene of the eighth International Congress of Applied Chemistry, 1912, Kellernan presented the following data:

QUANTITY OF COPPER SULPHATE REQUIRED TO KILL VARIOUS FORMS OF ODOR-PRODUCING ORGANISMS.

Copper Sulphate Required, Expressed as Parts, per Million Parts of Water—	
Anabæna	.09
Asterionella	.1
Beggiatoa	5.
Chara	.2 to 5.
Cladophora	1.
Cladothrix	.2
Clathrocystis	.1
Cœlosphærium	.3
Conferva	.4 to 2.
Euglena	1.
Fragilaria	.25
Hydrodictyon	.1
Kirchneriella	5. to 10.
Leptomitus	.4
Microspora	.4
Navicula	.07
Oscillatoria	.1 to .4
Peridinium	2.
Scenedesmus	5. to 10.
Spirogyra	.05 to .3
Ulothrix	.2
Uroglena	.05
Volvox	.25
Zygnema	.7

He adds a list of twelve genera of algæ that in his experience are causing trouble in reservoirs and ponds:

NUMBER OF OBSERVED CASES.	
Anabæna	27
Asterionella	9
Beggiatoa	20
Chara	26
Cladophora	17
Clathrocystis	23
Conferva	56
Crenothrix	13
Fragilaria	19
Spirogyra	43
Navicula	21
Oscillatoria	49

Jackson claims that blue-green algæ will die if the water be "coppered" one part to five million. His dose for Mellosira or Synedra is one to two million, and he claims that the former gives no odor of growth, but only that of decay. He finds that coppering runs out certain forms of organisms and substitutes others by a sort of selective action, but those thus substituted are not likely to be odor producers; and he further notes that, while "bottom" or decomposition odors are easily shaken out by aeration, "top" odors, viz., those of growth, have to be removed by filtering out the organism, or killing them by copper sulphate, or both. In his opinion, filtration of either type is effective for removal of odors of growth, but he believes that aeration would be worse than useless for living plankton, for the reason that the agitation would tend to mechanically release the oil causing the taste, which oil is not very easily oxidized.

Naturally the cost of treatment with sulphate of copper will depend in part upon the amount of the chemical that is to be used, which, in turn, is determined by the kind of organism that it is intended to kill; but it may be said that a mixed growth of Mellosira and Asterionella was removed from the Troy reservoir at an expenditure of 14.9 cents per million parts of water treated, labor included. The dose was one part of copper sulphate to 3,500,000 parts of water by weight.

In the article by Kellernan above quoted there are figures given indicating the safe limit for treating water with copper sulphate when certain fish are to be protected.

Copper Sulphate, Expressed as Parts, per Million Parts of Water—

Black bass	2.1
Carp	.3
Catfish	.4
Goldfish	.5
Perch	.75
Pickerel	.4
Suckers	.3
Sunfish	1.2
Trout	.14

It must be noted that these figures assume a thorough mixing of the sulphate solution with the whole body of water. They would not hold for the unequal distribution and resulting local concentrations already mentioned.

In some reservoirs which have been formed by the extensive flooding of swamp bottoms there may develop objectionable growths of Crenothrix, a general term denoting an aquatic plant which at times gives much trouble because of its tendency to develop in the street mains and clog the pipes. It is often discovered quite unexpectedly, being dislodged by the current attending hydrant flushing or by the draft caused by fire engines. Dead ends are spots likely to harbor it, and its long, rusty filaments have been mistaken for horse manure.

There are three types of the growth, each possessing the peculiarity of precipitating from the water in which it grows its own particular metallic hydroxide. By far the commonest of the three is Crenothrix Kuhniana, which demands iron for its development and which deposits large amounts of iron hydroxide as the result of its growth. The iron required for growth must be in solution, and the quantity demanded would seem to be about 0.3 part of Fe per million.

In order that the iron may be in solution, we naturally would expect the dissolved oxygen to be low and the quantity of reducing agents, such as organic materials, to be high, and those are the conditions that we find in practice to be favorable to the development of the plant.

It is likely to be encountered in waters from swampy, peaty sources, where dissolved oxygen is scanty and where the necessary iron in solution may be had. Driven wells in such localities frequently furnish it. Darkness favors its growth, and its development in city water mains is often excessive, resulting in a material reduction of the carrying capacity of the pipes. The writer has some doubt about the "manganese" variety of Crenothrix being as rare as some think it is, he having found large quantities of manganese in a heavy Wisconsin growth. Beythien and others have, moreover, noted that the presence of manganese in water directly favors the growth of the ordinary form of Crenothrix.

Beyond the mechanical stopping of street pipes, Crenothrix is exceedingly objectionable to the laundry interests of the community, for the reason that its rusty filaments cause "iron stains" to appear upon white linen.

Removal of the iron by oxidation and filtration is the best guard against troubles due to Crenothrix.

It must not be sweepingly assumed that all the "plankton" life is to be rated as uniformly objectionable; quite the contrary, as a reasonable degree of it acts as a distinct help in maintaining the safety of natural waters. Thus we find "bacteria eaters," such as many kinds of ciliated infusoria, rotifers, daphnia and the like, feeding upon minute germ life, and doing so to our great advantage.

To quote from a translation by Kuichling: "The question is, what becomes of the great quantities of offal and excreta, the many remnants of decaying plants, the refuse of communities, and the finely-divided factory wastes of every description, which find their way into our streams, even under normal conditions, if a large portion thereof is not consumed by the aquatic detritus-eaters and the omnivorous fauna before settling to the bottom?"

With a view to avoiding the troubles arising from the undue growth of taste and odor-producing organisms, the stripping of reservoir sites and the removal of a portion of the upper soil has been advocated and carried into practice. This, of course, entails very great expense when the surface to be stripped is at all extensive, as in the instance of stripping the Nashua reservoir supplying Boston. At Columbus, O., such work cost $159 per acre.

In their report upon the probable cost of stripping the surface soil from the Ashokan reservoir site, which is to hold the water supply for New York City, Messrs. Hazen and Fuller stated it would possibly reach the great figure of $5,000,000.

In view of the expense of such treatment for large reservoirs, the question is pertinent, "Does it pay?"

At Holyoke, Mass., the annual water report for 1908 says: "Great care had been taken in cleaning and stripping the reservoir by removing all vegetable and organic matter, thus lessening to a minimum the food supply for supporting living organisms in the water. The thoro cleaning of the reservoir has not been wholly successful, as an aquatic plant

known as 'Chara' has grown and flourished in the reservoir all summer and imparted to the water a taste and odor that made it unfit for drinking or even for cooking purposes."

Mr. J. M. Diven ("American Water Works Association," 1908) has had interesting and contrasting experiences with both stripped and unstripped reservoirs:

"The Elmira reservoir was as thoroly stripped as possible; great care was taken to keep out the first washing from the drainage area and the muddy flood waters. There was little or no marsh land on the drainage area, the catchment area being seemingly ideal. The reservoir was clean and clear; on the sides the slopes were abrupt, and there was very little shallow water.

"At Charleston, S. C., the drainage area was largely swamp, and there was much decayed vegetable matter on all of the area drained, the water being decidedly peaty. The reservoir covered a large surface, was shallow, and absolutely unstripped or even cleared. Much of the land flooded was composed of black muck or decayed vegetable matter.

"In the first case (Elmira) the conditions were at the first satisfactory and the water good for several years. But trouble from algal growth came in time and has steadily grown worse, in spite of strenuous efforts to remedy the condition.

"The second case (Charleston) was troublesome and unsatisfactory from the first, but has somewhat improved and promises to continue to improve."

The writer's experience leads him to advocate the expenditure of comparatively little money in the preparation of sites for large storage reservoirs, for the reason that, altho thoro stripping will likely give immunity from algal growths for some years, yet freedom from the occurrence of taste and odor in the stored water may not last for long. Sooner or later there will be carried into even the most carefully cleaned reservoir enough food material to sustain a plankton growth of a density governed by the local conditions. Broadly speaking, an "old bottom" is better than a new one, because it is likely to contain less plant food; but the rule has many exceptions.

Even natural lakes are frequently seen "in bloom"—that is, loaded with minute life—and they so remain for a period, during which their waters are not acceptable for domestic use. The character of the tributaries must be considered as well as the nature of the bottom of a proposed reservoir, for it is manifestly loss of money to improve the latter if the former can quickly replace much of what has been taken away.

For the sake of general appearances, if for no other reason, trees, shrubs and bushes should be removed. Dead, standing timber and fallen logs are most unsightly and are very likely to produce complaint from the visiting public. In other words, the reservoir site should be cleared and grubbed, with, of course, entire removal of every vestige of human habitation; but beyond that it scarcely pays to go. The portion of the flooded land lying between high-water and low-water marks should receive especial attention, for the reason that during the periods of its exposure it is capable, if uncared for, of presenting an unpleasant appearance and provoking adverse criticism, with the further objection that heavy weed growth may develop if it be long uncovered, which growth will contribute toward the production of taste and smell when the water again covers it.

In an instance where it was proposed to restore a dam that had been out of repair for over fifty years the writer advocated the cutting off of the standing dead timber at the existing water level before closing the breach, in order to insure a better looking sheet of water when the reservoir filled. This was for appearances only, as all extractive matter had been leached out of the old vegetation long before.

Aeration, filtration and the judicious occasional use of copper sulphate constitute the processes at our disposal for combating the annoyance arising from algal growths, and their use will give greater satisfaction than the expensive stripping of reservoir bottoms, a treatment which was so frequently advocated in the past.

Cost of Maintenance of Horse and Motor Fire Apparatus

The average cost of operating and maintaining motor and horse-drawn fire apparatus is very nearly as shown in the following statements, as the summary of careful study of results in cities in all parts of the country made by the engineers of the Robinson Fire Apparatus Manufacturing Co., prominent makers of motor apparatus in St. Louis, Mo.:

The pumping engine is the most important piece of apparatus in any department, for which the following figures of maintenance are correct:

Expense of pumping engine for one year—

632 gal. gasoline at 18c	$ 112.96
60 gal. of oil at 40c	24.00
15 gal. kerosene at 9c	1.35
10 lb. cup grease at 15c	1.50
General repairs	20.00
Driver's salary, 12 mo. at $95	1,140.00
Total cost of maintenance of auto	$1,299.81

Alarms answered, 136.
Distance traveled, 632 miles.
Pumped at fires, 97 hours.
Pumped at drills, 12 hours.

Cost of maintaining one third-size steamer for the same period of time is as follows—

Engineer's salary, one year	$1,200.00
Driver's salary	1,020.00
Feed for two horses, one year	360.00
Horseshoeing	48.00
Fuel for heater	324.00
Coal	30.00
Oil	2.00
Total cost maintaining steamer	$2,984.00

In addition there is also the cost of mantaining hose wagon, which is as follows—

Driver's salary, one year	$1,020.00
Feed for team	360.00
Horseshoeing	48.00
Total cost maintaining hose wagon	$1,428.00

It is seen, therefore, that the cost of maintaining a third-size steamer for one year is $2,984.00 and the hose wagon $1,428.00, which makes a total of $4,412.00 for the steamer and wagon, as against $1,299.91 for the auto engine combination complete, which is a saving per annum in favor of the auto of $3,112.19.

The auto engine will cover on an average four times the territory of a horse-drawn apparatus and will travel in a year's time four times as many miles in answering alarms. Depreciation or the interest on the investment will just about balance and so are not included.

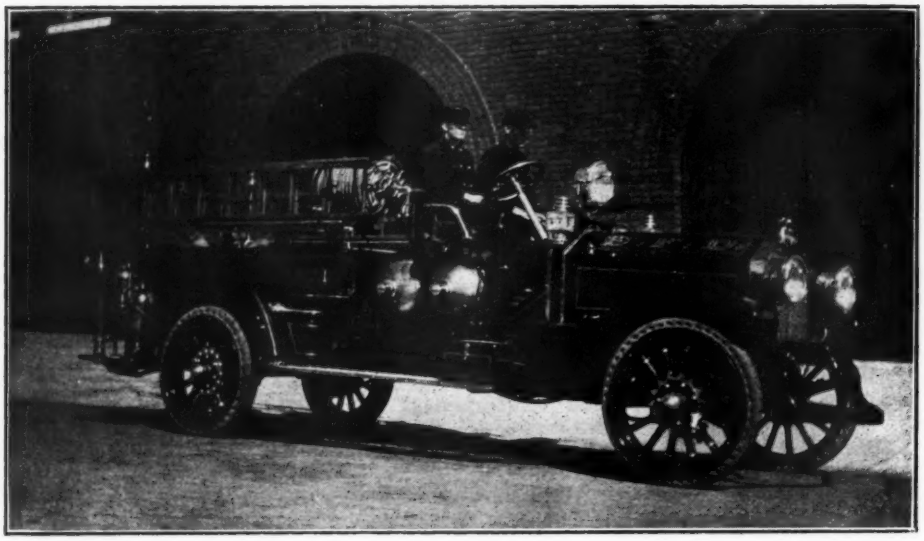
The engine doing the work as above stated will last twenty years and horse-drawn apparatus will last about the same length of time, but owing to having to purchase and train new horses the proportionate maintenance on the horse-drawn apparatus would exceed that of the motor apparatus.

Another point to be considered is the fact that in case of several alarms coming in in one day the horse-drawn apparatus, after it has answered one or two alarms, is unfit for any further duty, owing to the fact that the horses are exhausted, while with motor apparatus it will go to the last fire just as quick as to the first.

Another important item is the fact that in the steam pumping engine it takes from

PEORIA, ILLINOIS, *auto fire equipment. Robinson combination engine and hose; combination chemical and hose.*

ST. LOUIS *city service fire truck. Robinson hook and ladder auto truck.*



ROBINSON *motor driven combination chemical and hose wagon for use at Enid, Oklahoma.*

five to ten minutes to get up sufficient steam to do effective work and in case of a fire right at the engine house the firemen must sit still and wait until the boiler gets hot, while with the auto engine it is ready to furnish water the minute the alarm comes in. The chief expense of auto engine was formerly that of tires, owing to the fact that all pneumatic tires were used. For the heavy apparatus first class builders have now adopted cushion tires, of which there are several different types, and these tires are usually guaranteed by the tire manufacturer for a period of from one to three years, practically eliminating the tire expense.

The great saving in motor apparatus is possible, owing to the fact that practically all pumping engines carry their own hose and many of them their own chemical tanks, while with horse-drawn apparatus a hose wagon must always be maintained in addition to the steam pumping engine. This not only necessitates the two pieces of apparatus, but makes larger buildings necessary and in cities where real estate is valuable this is quite an item within itself.

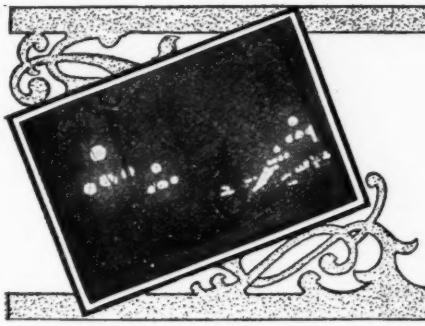
General repairs on motor apparatus from records made by chiefs using Robinson cars all over the country show an average expense slightly less than $20.00 per annum. This amount is, of course, decreased or increased, depending on the care the apparatus is given, but $20.00 will be the average amount expended on apparatus built by the best manufacturers.

Municipal Ownership in Belfast, Ireland

The total revenue of the electric supply undertaking for the fiscal year ended March 31, 1913, was $394,595, as compared with $353,167 the preceding year, an increase of $41,428. The total revenue from electric light and power supply was $276,320; from tramway supply, $116,246, and from other sources, $2,029. The total cost of the undertaking amounted to $227,526 in 1912-13, an increase of $29,506 over the preceding year, leaving gross profits, before providing for interest and sinking fund, of $170.069 in 1912-13 and $155,147 in 1911-12. The total capital employed at the end of the fiscal year 1913 was $2,419,010, the percentage of gross profit to average capital employed being 7.03.

The total number of units sold in 1912-13 was 16,738,143, as follows: Private supply, 6,931,854; public supply, 72,869; traction supply, 9,733,420. In 1911-12 there were sold 15,021,964 units. The total capacity of the plant at the end of the fiscal year was 10,300 kilowatts.

Electric current is supplied for lighting purposes at a flat rate of 3½d. (7 cents) per unit, and for lighting private residences at a flat rate of 3d. (6 cents) per unit.. There is, however, an alternative rate on the maximum demand system. For heating and power purposes the rate is graded on the maximum demand system from 2¼d. to 1¼d. (4½ to 2½ cents) per unit, according to the quantity used. The average price per unit obtained in the fiscal year ended March 31, 1913, was 2.18d. (5.62 cents) for lighting, 1.224d. (2.448 cents) for power, and 0.589d. (1.178 cents) for tramway supply.



Lighting

Tungsten Lamps of High Efficiency

By Irving Langmuir and J. A. Orange, before the A. I. E. E.

Radical improvements in the efficiency of tungsten lamps can be obtained by preventing evaporation of the filament or by preventing blackening of the bulb. By the introduction of considerable pressures of such gases as nitrogen or mercury vapor into the lamp the blackening can be practically avoided and the evaporation of the filament reduced very considerably.

By making use of these principles we have been able to construct practical tungsten lamps which, starting at an efficiency of about 0.40 watt per candle, have run over two thousand hours, the average efficiency during life being better than 0.5 watt per candle. It should be pointed out at the outset, however, that such a degree of improvement as this has been reached only in lamps taking large currents.

The early experiments with lamps containing nitrogen at atmospheric pressure were made with ordinary single loop filaments of 0.005 and 0.010 inch diameter placed in long heater lamp bulbs. These lamps were set up on life test at such a voltage that the temperature of the filament was 2577 deg. C.

In order to compare these with ordinary lamps, similar lamps with evacuated bulbs were set up on life test with the filaments at the same temperature.

The nitrogen-filled lamps with the filaments 0.005 inch diameter gave an efficiency of 0.65 watt per candle and had a life of about 90 hours, whereas those with the larger filaments (0.010 inch diameter) gave an efficiency of 0.56 watt per candle and a life of about 300 hours. The bulbs opposite the filaments remained clear, altho a slight brown deposit of tungsten nitride collected in the upper part of the bulbs. The candle-power of these lamps remained above 80 per cent. during their entire life, failure being due in every case to breakage of the filament after this had decreased considerably in diameter.

The vacuum lamps, on the other hand, gave an efficiency of 0.41 watt per candle, but the bulbs blackened rapidly, the candle-power falling to 80 per cent. in about 40 minutes. Since the filaments of the vacuum lamps burnt out after 2 to 5 hours, whereas those of the nitrogen lamps lasted 50 to 100 times as long, it is evident that the rate of evaporation of the tungsten is materially reduced by the presence of the nitrogen.

These results indicated clearly the desirability of using a filament of large diameter. The larger filaments gave not only a better efficiency at any definite temperature, but also a much longer life. Thus doubling the diameter increased the efficiency form 0.65 to 0.56 and increased the life from 90 to 300 hours. The improvement in the efficiency, as was pointed out in the previous article, is due to the relatively greater heat loss by convection from small wires. The life of the filament is determined largely by the loss of tungsten from the filament by evaporation and has been found to be dependent on the relative decrease in diameter caused by this evaporation. If the rate of evaporation per unit area from large and small wires were the same, the lives of various filaments run at a given temperature would be roughly proportional to their diameters. However, as the evaporation of tungsten in nitrogen is largely a diffusion process, it probably obeys laws similar to those of conduction or convection of heat from a wire; that is, for wires of small diameter, the actual amount of tungsten evaporated would be nearly independent of the size of the wire. The rate of evaporation per unit area would thus be approximately inversely proportional to the diameter. The relative lives of very small wires in nitrogen are therefore nearly proportional to the squares of their diameters.

These results were decidedly encouraging, for both efficiency and the life of the lamps can be improved by increasing the diameter of the filament.

It is, however, not desirable to use filament of very large diameter if similar results can be obtained with smaller ones. The current taken by a filament increases

approximately with the three-halves power of the diameter. Thus, for wires of the sizes used in the preceding experiments, the currents needed to maintain a temperature of 2577 deg. C. were approximately:

Diameter		Current
Inches	mm.	Amp.
0.005	0.127	3.0
0.010	0.254	8.5
0.020	0.508	24.0

Unless very low voltages are used, the power consumed with the larger wires is so great that only very high candle-power lamps can be made.

Therefore it was of vital importance to increase the effective diameter of the filament without decreasing its resistance, and various methods of doing this were tried.

This result may, for example, be obtained by using a tubular filament. The method which has thus far proved most satisfactory, however, is to wind the filament into the form of a tightly coiled helix.

The use of a helically wound filament presents several very interesting features. The life of ordinary single loop filaments is limited by the irregularities in diameter which develop after a considerable amount of tungsten has evaporated. These irregularities, after they first appear, tend to magnify themselves very rapidly, on account of the tendency for the current to overheat any spot which becomes thinner than the rest of the filament. The overheating increases the rate of evaporation and rapidly causes failure.

In the gas-filled lamps, however, when helically wound filaments are employed, a new factor is introduced which entirely counteracts this tendency to overheat in spots. In designing the filaments of these lamps, it is evidently desirable to wind the filament on as large a mandrel as possible, in order to obtain the advantage of the large diameter. Since tungsten is a relatively soft material at the operating temperature of these lamps, too large a mandrel should not be used, as otherwise the weight of the filament pulls out the helix very materially in a few hours, and the heat lost by convection may thus become greater than if a helix of smaller diameter had been used. In actual practice the filament is designed so that the amount of sagging during life will be perceptible, but not enough to cause too great a change in the characteristics of the lamp.

If, during the life of the lamp, any part of the filament should, for any reason, evaporate more rapidly than the rest, so that the filament becomes somewhat thinner, this portion will have less mechanical strength than the rest and will therefore sag more rapidly. The helix will therefore open out wherever the filament becomes thin or becomes overheated. This will cause increased heat loss both by convection and radiation, and thus prevent local overheating or spotting.

The use of helically wound filaments increases the life of the lamp many times beyond the life that would be obtained with a straight filament running at the same efficiency. This is especially true of the smaller sizes of wire.

Besides the helically wound filament, various other forms have been tried, and, for special purposes, many of these have decided advantages.

In the ordinary evacuated lamp, the choice of a suitable bulb is a comparatively simple matter. It must be of convenient size and shape, and provide sufficient room for the proper mounting of the filament. Furthermore, it must have as large an inside surface as possible, so that the density of the deposit of evaporated tungsten will be small. It is also desirable to have the bulb at a sufficient distance from the filament and so related to the power input into the lamp that the bulb does not become overheated. This latter is not only desirable from the view point of safety (in case of lamps for domestic service), but because it is difficult to remove water vapor so thoroly from the bulbs that the life of the lamps will not be greatly shortened by an overheating of the glass.

In the nitrogen-filled lamps, however, several other factors must be considered, especially in the lamps of high candle-power.

In ordinary lamps about 20 per cent. of the energy radiated from the filament is intercepted by the glass and causes heating of the bulb. In the nitrogen lamp, beside this radiated heat, there is an additional amount of heat carried to the bulb by convection—an amount varying with the type of lamp and ranging from 6 to 40 per cent. of the total input. The convection currents carrying this relatively large amount of heat travel vertically upwards from the filament and strike a relatively small area of the bulb, which thus tends to become greatly overheated. Unless special precautions are taken, this overheating will cause the liberation of enough water vapor to cause attack of the filament and consequent blackening of the bulb. It is thus highly desirable, in ordinary cases, if small bulbs are to be used, that the filament should be placed in the lower part of the bulb. This has the further advantage that it allows sufficient surface of glass in the upper part for the deposition of the tungsten nitride.

For a similar reason it is generally desirable, altho not necessary, to make the bulbs with their height considerably greater than their horizontal diameter.

By special design of the bulb, satisfac-

tory lamps have been made with bulbs of only one-half to one-third as large a volume as that of evacuated lamps of the same wattage. This means that for bulbs of the same volume the nitrogen lamps give roughly from five to ten times the candle-power of evacuated lamps. The bulbs of such lamps naturally run much hotter than those of ordinary lamps. The upper parts of the bulbs are often 100 to 200 deg. cent. or more, while the lower parts are sometimes much cooler than this, although closer to the filament.

Several special varieties of heat-resistance glass have been used for the bulbs, making considerably smaller ones possible, as well as rendering it easier to get rid of water vapor. Transparent quartz bulbs have been tried, but do not seem to have sufficient advantage over some of the special glasses to offset their present high cost.

For some of the larger size lamps which take heavy currents (20-30 amperes) it has been necessary to devise special types of lead-in wires. Platinum has been discarded entirely, even in the smaller sizes. Several types of heavy current leads have been successfully used. Most depend on the use of special alloys which have the same co-efficient of expansion as the glass. Bulbs of special glasses into which tungsten or molybdenum wire can be sealed directly, have also been used.

In many of the larger lamps the lead-in wires pass thru the lower end of the lamp. In this case they can be made short. In others, however, the leads are brought in from the top. This requires more care in the construction of the seal if it is exposed to the heat from the convection currents. Screens are sometimes used to protect the seal or other glass parts from direct contact with the convection currents, and to reduce convection.

We have seen that at constant temperature, both the efficiency and the life improve as the diameter of the wire is increased. With very large wires (0.020 to 0.040 inch diameter) which take 20-60 amperes, the efficiency may reach 0.40 watt per candle and probably even better, and yet give a life over a thousand hours. It probably be worth while, in some cases, to use nitrogen in low-current lamps, even if an efficiency no better than that of vacuum lamps is obtained, in order to gain certain other advantages of the nitrogen-filled lamps, such as better color of the light, higher intrinsic brilliancy, etc.

The principal limitation of the new type is therefore that of current. There is no practical upper limit to the current, provided the voltage is not lowered to keep constant power consumption. (As an example, a lamp taking 60 amperes and giving 6,600 candle-power at 0.40 watt per candle has been successfully run.) With increasing current, larger and larger filaments are used and the efficiency that may be practically reached increases towards the limit of 0.20 watt per candle, which is fixed by the melting-point of tungsten. Unless special expedients are employed, the cooling effect of the leads lowers the efficiency of the lamps by an amount that is inversely proportional to the voltage and nearly independent of the size of the wire or the current strength.

With voltages of 20 volts or more, this effect is not serious, but for voltages as low or lower than 10 volts, it may become very important.

For the particular type of nitrogen-filled lamp which has at present been furthest developed, it may be said that a life of over 1,500 hours is obtained at efficiencies better than 0.50 watt per candle only in large units taking over ten amperes. Lamps running at 0.6 to 0.7 watt per candle have been made in units taking at least 5 amperes.

No serious difficulty has been met in making high-voltage lamps. In nitrogen at atmospheric pressure there is no tendency toward arcing, even at 250 volts. Many lamps taking 6 or 7 amperes at 110 volts have been made up and run at 0.6 to 0.7 watt per candle, with a life of over 1,000 hours.

A number of special types of nitrogen-filled lamps have been made and tested. Among these the most interesting, for the present, are perhaps the following:

1. Large Units of Very High Efficiency (0.4 to 0.5 watt per candle with a life of 1,500 hours or more). These take currents of 20 to 30 amperes and (except in units over 4,000 candle-power) are therefore best run from a.c. circuits by means of small transformers or auto-transformers giving a voltage depending on the size of unit desired. Thus, with 30 volts and 25 amperes, the power would be 750 watts and this, in a lamp of say 0.45 watt per candle, would give 1,670 candle-power. Higher or lower candle-power may be obtained by using other voltages. Typical lamps of this kind are shown in Figs. 1 and 2.

2. Small Units of Low Voltage. These take currents of ten amperes or less and voltages as low as four or five volts. The efficiencies with 1,000-hour life range from 0.6 to 1.0, or even 1.25 watts per candle, according to the current used.

These lamps are adapted for series street lighting on 6.6-ampere circuits (at 0.6 to 0.7 watt per candle), for stereopticon lamps, automobile headlights and in general wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

3. Lamps to Run on Standard Lighting Circuits (110 volts). Large units of this

type (several thousand candle-power) have efficiencies of 0.5 watt per candle or better. With smaller units the efficiency is ordinarily not so high.

A lamp of this type is illustrated in Fig. 3. The leads may be brought in from the top, in which case they are preferably made longer so that the filament remains in the lower part of the bulb.

Besides its high efficiency, the features of the new lamps which may, at least for certain purposes, prove of advantage, are:

1. Color of the Light. The temperature of the filament being 400 to 600 deg. higher than that of ordinary lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the d.c. arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be had for a few minutes by running an ordinary tungsten lamp at double its rated voltage.

Work is at present under way to develop special color screens which, when used with this light, will give a true daylight color (corresponding to the radiation from a black body at 5,000 deg. C.). From measurements with the spectrophotometer, it can be calculated that the screens which will accomplish this purpose will absorb from 65 to 75 per cent. of the light, so that the net efficiency will be about 2.0 watts per candle for a pure daylight color. At present, to accomplish this purpose with ordinary tungsten lamps, screens must be used which absorb so much light that the net efficiency is between 10 and 12 watts per candle.

2. High Intrinsic Brilliancy of the Filament. At the operating temperature of the nitrogen-filled lamps the intrinsic brilliancy of the filament is about 1,200 candle-power per sq. cm. In ordinary tungsten lamps, on the other hand, running at about 1.25 watts per candle, the filaments have a brilliancy of only about 150 candle-power per sq. cm. The brilliancy of the filament of the nitrogen lamp is thus about eight times that of the ordinary lamp.

This feature, combined with the high degree of concentration preferably used, renders these lamps particularly useful for projection work, such as for headlights or for stereopticons.

3. Constancy of Characteristics During Life. It is often possible to so design these lamps that their ampere, volt, and candle-power characteristics remain practically fixed during the greater part of their life. In any case, however, since there is no deposit on the bulb to cut off the light, the candle-power practically never falls below 75 per cent. (this decrease sometimes being due to sagging). The lamp usually fails by the breakage of the filament with the candle-power well above 80 per cent. of its original value.

Light Distribution of Nitrogen-Filled Lamps. In the preceding paper, wherever efficiencies of lamps have been given, they are expressed in watts per horizontal (international) candle measured in the direction perpendicular to the plane of the filament if this is in the form of a single loop.

Careful measurements have shown that with helically wound filaments the distribution of light in a horizontal plane is almost perfectly uniform, therefore the efficiencies that have been given may be considered to represent also watts per mean horizontal candle.

The spherical candle-powers of many of the lamps have been measured. The ratio of mean spherical to maximum horizontal (practically mean horizontal also) candle-power has been found to average about 84 per cent. for the lamps made with single loops of helically wound wire.

It is possible to design the filaments of nitrogen-filled lamps so as to give a maximum of candle-power in a given direction. This is being done in stereopticon lamps.

Strong Incandescent Lamps for Ornamental Street Lighting

Novalux ornamental units designed for ornamental street lighting, are made for both series and multiple operation and will accommodate the 400 and 600-c. p. 6.6-amp. and the 600 and 1000-c. p. 20-amp. sizes of the series Mazda, and the 400, 500, 750 and 1000-watt multiple Mazda lamps.

They are made in two general styles, the only difference being in the glassware equipment. The glassware on one style consists of a medium alabaster globe, which is so shaped that it is completely filled with light and permits a certain amount of light to pass upward and illuminate the building fronts. There is a small reflector placed at the top and inside of the globe. The function of this reflector is to direct downward and make useful the light that would otherwise be lost in the bottom of the ventilator surmounting the globe. The other style of unit has a two-piece globe. The bottom part is made of crystal rough-inside glass, while the top is made of pyro glass. No reflector is used, as the pyro top is made of dense glass having the inside glazed, thereby reflecting downward some of the light, altho enough filters thru to illuminate properly the building fronts.

These new units are highly ornamental and the casings, which are designed to form the capital of the pole, are made in four different styles, from which a selection can be made to harmonize with the pole design.

NOVALUX *ornamental lamp and post designed together to produce the most artistic appearance day and night.*

Ventilation has been given very careful attention. Air enters thru small holes in the globe seat and leaves thru concealed openings in the spun-copper ventilator at the top of the globe in one form, and in the other it leaves thru the space provided between the top and bottom globe. The socket used in these fixtures is made in skeleton form, which permits a circulation of air to all parts.

As the efficiency of the 20-amp. Mazda series lamps is much higher than that of the 6.6-amp. lamps, the Novalux ornamental series unit contains an internal individual compensator mounted inside of the ornamental casing. These compensators operate the 20-amp. lamps on 6.6 or 7.5-ampere circuits. This saves about 50 per cent. of the energy required to operate the lamps and permits them to be connected in standard existing circuits, thereby allowing the extension of the lighting system without additional station equipment. The compensator also reduces the effect of destructive current surges that may be set up by arcing or permanent grounds.

Gas Cluster Lighting

The improvements in the manufacture of gas, resulting in reduction in cost and the invention of incandescent mantels and like intensifiers of gas light, have resulted in advances in gas street lighting which are quite as remarkable in their way as are the recent improvements in electric lighting. A recent development in the gas lighting field is cluster street lighting with the "gas white way" installations, one of which is shown in the accompanying photograph.

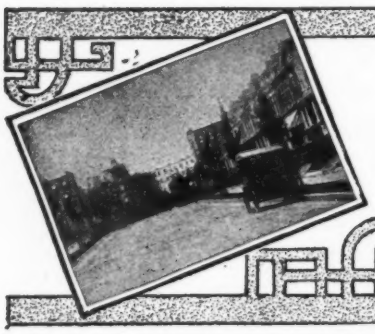
The Sun gasolabra, shown in the photograph is the product of the Sun Vapor and Gas Street Light Co., of Canton, O., and is said to produce about three times the actual candle power in electric standards of similar design using tungsten lamps inside the cluster globes. The character of the lights and of the illumination of buildings is indicated in the photograph but not given full justice.

The Canton, O., installation began two years ago with fifteen 5-way cluster gasolabras on one block and has developed until there are now about 150 in service, all maintained by the business men without expense to the city.

The ordinary 5-lamp electric standard produces 400 candle power or less, according to whether 40, 60 or 100-watt lamps are used. A 5-lamp gasolabra produces 750 candle power, being 150 candle power from each of the five double burners. With natural gas the candle power is increased to about 1,000.

A variety of designs of posts and lamp supports for one, two, three, four or five single or double burners is offered in the company's catalog, with one upright burner and two or four inverted burners. The Sun Street Light Co., Canton, O., will furnish full particulars.

GAS WHITE WAY *at Canton, Ohio, showing satisfactory illumination of street and buildings with five-light gasolabras.*



ROADS AND PAVEMENTS

The Perfection of the Modern Street Pavement

By Frank W. Cherrington.

The slogan "Good Roads" has been made a national issue. Municipalities would do well to paraphrase this expression to "Better Street Pavements."

In the development of a perfect paving material municipal engineers have held steadfastly to one ultimatum; it was essential that such material should permanently resist the abrasion of constantly increasing volumes of traffic. The stupendous expenditure of time, energy and money annually consumed by street maintenance, could then be diverted toward the installation of additional pavements of a permanent character.

Engineers concede that the modern creosoted wood block approaches closely the ideal paving material, in its durability and desirability, for either residential or business streets. Experience of a great many years has proven conclusively that this material would not wear out under the heaviest traffic, or decay under extreme climatic conditions. It has been satisfactorily demonstrated that it ranks with the highest in all the requirements for durability, resilience, smoothness, sanitation, quietness, cleanliness, dustlessness, ease of installation, and removal for pipe work, lowness of tractive resistance, and, when taking into consideration their longevity, lowness of first cost.

Advances along still further development should be encouraged, as it is only from the collaboration of inventions and suggestions that real progress is made toward perfection.

Blocks with one lug on the end and two lugs on the side, extending the full depth of the block and being an integral part of the same, have inexpensively and effectually solved the last of the perplexing problems involving the permanence of creosoted wood block paving construction. They have successfully withstood many tests of their practicability, under various traffic conditions, extending over a long period of years. The lug blocks represent the highest efficiency obtainable from modern paving engineering, and the engineers interested in permanent street pavements are rapidly including them in their general creosoted wood block specifications.

During the many years that the ordinary wood block pavements have been under close observation, only three factors were found which prevented their permanence and absolute satisfaction. These factors were found to be:

First: The natural tendency of wood block, either treated or untreated, is to absorb water and to swell or expand. Expansion often proceeds beyond the limits provided in the expansion joints along the curbing, and the pavement then follows the line of least resistance and bulges upward, or buckles.

Second: Bleeding, due to the efforts to prevent this expansion by forcing superfluous injections of creosote oil into the wood as a means of waterproofing the blocks. This practice, until recently generally followed, succeeded in only partially waterproofing the block, so that buckling still occurred with startling frequency. The resultant action of the combined forces of the expansion of the wood, the surplus creosote and the air content in the wood cells caused the surplus creosote oil to bleed or exude to the surface of the pavement, to the great annoyance of traffic and pedestrians.

Third: The slippery condition of the pavement, both on gradients and levels, in wet weather.

These three objections to wood block, altho in existence for over fifteen years, have not been sufficiently serious to prevent its adoption on a large scale by almost every city of importance. However, these objections have retarded its general adoption as the standard for municipal street pavements.

Lug blocks absolutely eliminate all three of these problems affecting the permanence of creosoted wood block pavements, and they may now, without fear of contradiction, assert their claim to the perfect paving material.

KREOLITE LUG BLOCK *pavement on Jackson avenue, Toledo, Ohio, June 27, 1914. These blocks were laid in the early summer of* 1912. *They are three inches deep, with sand filler. Grade about four per cent.; heavy travel; no cobbling or brooming of edges. Note crushing of some of the lugs on ends of blocks, thus taking care of expansion without bulging.*

Countless experiments have been made during the past fifteen years, in varying the method of the preservative treatment of wood blocks, and changing the quantity and quality of the injected creosote oil. All such experiments have shown the futility of trying to prevent that unchangeable law of nature, the phenomena of the expansion of wood when absorbing moisture. The injection of large and small quantities of creosote oil, whether it be a pure distillate or a combination of creosote oil and coal tar, will do no more than partially waterproof wood block. It has been found that no matter how carefully specifications are prepared, there is a possibility of the ordinary rectangular creosoted block, sooner or later, expanding or buckling. The one practical method of guarding against this possible emergency is to provide a careful, uniform spacing between the ends of the blocks as laid. But it is an impossibility to force laborers to gage correctly a proper and uniform space in laying the blocks. If ordinary rectangular blocks are used the method of spacing should permit the free and unrestricted expansion of the blocks, guarded in some manner by spacers.

Lug blocks automatically provide for this uniformity of spacing by the lug protruding one-fourth inch from the center of one end of each block. This lug is an integral part of the block, and extends its full depth in the direction of the grain. Any laborer is able rapidly to lay lug blocks with an absolutely uniform spacing between blocks. As the lug blocks absorb moisture and expand, either longitudinally of the street or transversely, these lugs are compressed, allowing the pavement to take up any excessive expansion within itself, without bulging. Since it is never possible to foretell just when an ordinary rectangular creosoted wood block pavement will expand, the lug blocks provide a very desirable factor of safety, preparing the pavement for any possible emergency.

Many large railroad systems of both this country and Europe are annually creosoting great quantities of large dimension structural, bridge and cross-tie timbers with so small a quantity as four pounds of oil per cubic foot of timber, and are prolonging their service twenty

or thirty years beyond their normal untreated life. Paving blocks in this country, of very small dimensions, have been treated with such excessive quantities as twenty to twenty-two pounds of creosote per cubic foot of timber, not because such large quantities are necessary to prevent decay, but in an effort to so waterproof the blocks that swelling or expansion would be prevented.

New York and Boston first treated wood block with eighteen pounds of oil per cubic foot of timber. Buckling occurred and this quantity was increased to twenty to twenty-two pounds per cubic foot, but it was found that even then the blocks continued not only to buckle, but to bleed profusely in warm weather. The specifications for creosoted wood block of many municipalities are now reducing the quantity of oil required to be injected from twenty to sixteen and twelve pounds per cubic foot, and, since it has been proven that heavy injections of oil do not prevent expansion, the probabilities are good for still further reduction. An injection of twelve pounds of creosote oil per cubic foot of timber is the maximum quantity used abroad for treating paving blocks, and is more than sufficient to preserve the blocks indefinitely from decay. With expansion provided for by individual expansion joints, or lugs, on each block, it is then necessary to treat only to preserve.

At present experts disagree as to the true cause of bleeding in wood block pavements, but all are agreed that it is greatly increased by the surplus quantities of oil injected into the wood. The quality of the injected oil does not seem to affect the tendency of the blocks to bleed. Lug blocks treated with twelve pounds of creosote per cubic foot not only prevent bulging, but at the same time reduce bleeding to a minimum. The smaller the amount of injected oil, the less trouble there will be from bleeding.

Creosoted wood block pavements are no more slippery in inclement weather than sheet asphalt or other composition pavements, but still this objection remained to be eliminated before perfection was attained.

Several unsatisfactory methods of preventing slipperiness have been tried, but the only practical, economical and efficient method of construction is to provide two lugs, spaced about five inches apart on one side of each block, in the same manner as the end lug above described.

These "Kreolite" lug blocks are not awkward to install, and may be laid as rapidly as ordinary rectangular blocks, since the lugs are an integral part of the block they show no tendency to work to the surface of the pavement, and since they extend the full depth of the block they will not wear smooth under traffic.

A sand or bituminous composition may be used as a filler for the interstices made by the lugs. In either case, excellent results have been secured. When a sand filler is swept into the joints, the sand unites with the creosote on the side of the block and forms a waterproof mastic.

Another advantage of the lug block is the impossibility of any workmen placing the blocks in position with the grain horizontal instead of perpendicular to the surface of the pavement. It has often been demonstrated that workmen, in laying blocks of the same depth and width, are unable to determine quickly which side of the block should be placed up. It is very evident that the wearing surface of wood placed with the grain parallel to the surface of the pavement does not resist traffic abrasion for any length of time, while wood placed with the grain vertical to the surface of the pavement will wear indefinitely, as a mallet, slowly and uniformly.

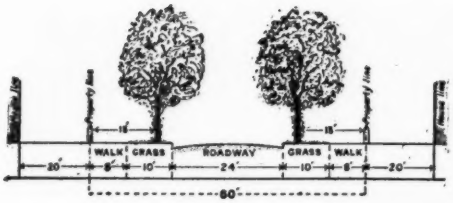
Having successfully solved the problems involved in the elimination of bulging, bleeding and slipping of the ordinary rectangular creosoted wood block construction "Kreolite" lug blocks have gone far toward the development of the long sought perfect permanent street paving material.

Evolution of a Business Street

THE solution of the problem of the congestion that is found in the main streets of towns is to plan residential roadways so that they may be transformed gradually into business streets at a minimum of expense. One way in which this may be done may be understood by a glance at the accompanying illustrations.

The upper diagram shows a street 60 feet wide and suitable for a residential section. The roadway is of moderate width, sufficient to accommodate the light traffic of delivery wagons, carriages, etc., that serve the houses on either side. A boulevard and trees give it a pleasant appearance, and, also, the houses are set back 20 feet from the property line, with gardens or lawns between them and the sidewalk.

If commercial interests should invade this region, property owners would, under ordinary circumstances, build forward to the sidewalk, partly to use the extra space, but chiefly to bring store windows flush up to the causeway. A portion of the street in process of transformation presents a very ragged appearance, due to the lack of a uniform building line. When the process is complete, the once beautiful residential street has become a congested



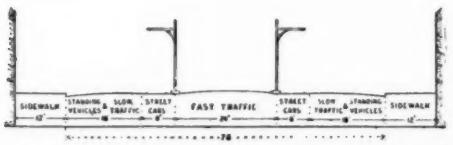
LAYOUT OF RESIDENCE *street with twenty-foot reserve in front of building line.*

business thorofare with narrow walks and a 44-foot roadway. To widen it would necessitate the tearing down of valuable buildings and would be a heavy expense to the taxpayers.

Foresight would obviate this undesirable development. All that is necessary is to establish a restriction prohibiting the use of land for building beyond an established line. Legally, of course, this involves compensating the property owners, but the damages can be distributed over a long period in a simple way. No property rights need be acquired by the municipality until application is made for a building permit on an obstructive site, and then the restriction can be imposed and paid for. In this way the public thorofare is gradually widened at exactly the same rate as the growing commercial interests require. At no time is it necessary to pull down buildings. When any considerable number of property owners require it, the walk may be moved over to the building line and the roadway widened. The trees should be left as long as possible, and, unless a street railway is constructed, should be a permanent feature.

The lower diagram shows the ultimate development of the 60-foot street into a 100-foot thorofare. Safety for pedestrians crossing the wide roadway is provided by "islands" at the base of each pole holding the electric wires. Motor-cars may run up and down the middle unimpeded by slow-moving wagons and drays, while the latter have ample room to pass between the street car tracks and standing vehicles by the sidewalk.

SAME STREET *after it has developed for business purposes, with reserve condemned and thrown into sidewalk and roadway.*



In connection with the above it is interesting to compare the following extract from a recent address by Mr. Raymond Unwin, F. R. I. B. A., before the Victoria League Imperial Health Conference in London: "There are certain requirements of town planning which are fairly obvious and generally applicable, such as the prevention of the overcrowding of dwellings, and the fixing of such a building line on all the main highways radiating out of the town into the country, as will prevent buildings being erected so near to these roads that future widening can only take place at excessive cost after demolition of the buildings."

The Cost of Good Roads

Approximately $206,000,000 was spent last year on public roads in the United States, according to statistics prepared by the U. S. Department of Agriculture. In 1904 the total was only $79,000,000. In nine years, therefore, the increase has been over 250 per cent.

This awakening on the part of the country to the importance of good roads has, experts say, been due in great measure to the principle of state aid to counties and other local communities. New Jersey began the movement in 1891, when it passed its State Highway Law. Massachusetts and Vermont followed a year later, but for the most part the other states were slow to move. In 1904, only fifteen had state highway departments; today there are only six that have not. In 1913, the individual states appropriated a total of $38,755,088, to supplement local expenditures.

The value of this state aid is, however, not to be measured by the figures alone, for the bulk of the money comes, and always must come, from the counties and townships. Thus, in 1912, the cash outlay by counties, districts and townships, was $137,493,985. Complete figures for 1913 are not yet available, but it is safe to estimate the sum at approximately $151,000,000. To this must be added some $15,000,000 to represent the value of the labor contributed instead of cash in districts where this practice prevails. Last year, therefore, local communities contributed, in round numbers, one hundred and sixty-six millions of dollars, as against appropriations from state treasuries of $38,755,088. The true importance of this thirty-eight millions lies in the fact that it means expert supervision of the expenditure of a considerable portion of the vast sum of two hundred millions. When each county built as it chose and when it chose,

GRACEFUL *concrete highway bridge with light appearance, due to use of ribbed concrete arches.*

the services of trained engineers were usually out of the question. There was little opportunity to test innovations, little advance in the science of road-building, and there was also difficulty in arousing each county individually to do its best to improve conditions within its own limits. State aid has changed all this. The best engineering skill is available for all works of importance, there is cooperation and a constant stimulus to further improvements. The money contributed by the states not only builds more roads, but it makes better those that other money builds.

At the present time there are in the United States 20,741 miles of roads improved either wholly or in part by state aid. This is nearly the mileage of the French routes nationales, the system of great national highways which is the envy of every civilized nation. The routes nationales are, of course, only a small part of the total mileage of France, where practically every road of any importance is an improved road, and France is a much smaller country, both in area and in population that the United States, so that this comparison is not, in itself, very flattering to our progressiveness. It shows, however, that we have at least made a beginning. Of the 2,226,842 miles of roads in the United States, 233,774 miles, or approximately 10 per cent., are classed as improved.

A Ribbed Arch Highway Bridge

The general lines of the concrete arch bridge are in themselves harmonious, a fact which is fortunate considering the large number of bridges designed without architectural supervision. But in some locations, especially where the approaches consist of deep fills and the roadway is carried at considerable height over the stream bed, the concrete arch has too massive appearance for greatest beauty. In some of the larger city bridges of recent construction, arch ribs have been used with a skeleton system of columns and beams supporting the bridge floor slab. While this was primarily developed to save yardage of concrete, by designing each member to carry its full permissible load, yet the results have been most pleasing in appearance and have given to the bridge designer an opportunity to combine the lightness and freedom commonly associated with suspension bridges with the most permanent material—concrete.

An example of ribbed arch design was built for the city of Fulton, Missouri, to span a creek within the city limits. It replaced an old light steel span whose removal was a part of considerable road and bridge reconstruction by the Fulton Special Road District.

General plans were prepared by the road district engineer and bids were solicited from contractors, which were to include a detailed design based upon the general plan. The appropriation for the bridge was scarcely enough to do the work. That the arch ribbed type was chosen for a span of 66 feet under these conditions, indicated an economic advantage afforded by arch ribs which might be used much more widely.

The bridge slab accommodates a roadway 24 feet wide including a sidewalk.

The arch has a rise of 15 feet and the two ribs are each 4 feet wide and spaced 18 feet center to center. The foundations go down 6 feet to rock. The floor system is a concrete slab supported on cross girders which are in turn supported on columns rising from the ribs, with the exception of the center two girders which rest directly upon the ribs. In order to anticipate cracks in the slab at points of flexure, expansion joints were provided for over each of the two cross girders at the crown of the arch. It is not thought that a deflection sufficient to require expansion joints will occur between these points and the abutments.

The roadway was designed to carry a live load of 200 pounds per square foot uniformly distributed, or a concentrated load of a 20-ton road roller, and the sidewalk to carry an 80-pound uniform live load. The stresses permitted in concrete and steel were 600 and 16,000 pounds per square inch respectively.

The abutment consisted of end walls and wings, the latter being strengthened by two inner buttresses.

Unlike the usual arch bridge practically all of the concrete is subject to stress so that a 1:2:4 mixture, using a good quality of crushed limestone and clean river sand, was used thruout. The material was such that a uniformly light concrete resulted, and with the exception of the hand rail, no part of the surface was brushed or painted to better its appearance. The reinforcement consists of square corrugated bars.

The arch was designed and built by Abbott & Wagner, contractors of Kansas City, Mo., and built under the direction of W. R. Heagler, engineer of the district. Universal cement was used.

Objects of the Indiana State Highway Commission

The State Highway Commission of Indiana, recently appointed by Governor Ralston to examine into road conditions and road laws of the state, held its first meeting with the advisory commission in the Senate chamber of the State House, July 15. President Harris' address to the commission was notable in explaining the present road laws and road conditions in the state and outlining the work that the commission is expected to do, and included the following points:

The Governor has created this commission to investigate and consider means and measures for unifying, simplifying and improving the present system of constructing and maintaining public roads.

Indiana is approaching her first centennial. Its population is three millions; that is one hundred persons to each square mile. Great advancement is being made in agriculture. Manufactures are increasing thruout the state. The population and business of the state will naturally multiply rapidly in the future. The agricultural and industrial interests, as well as the people at large, are insisting that the public roads shall be made better, both in construction and maintenance.

Good roads all the year round are necessary for general thrift, progress and comfort. And it is felt thruout the state that the time has come that a better system might be provided than the present laws afford. The present system of laws for the construction and maintenance of public roads may be summarized as follows:

All public roads belong to the state and are under its legislative power and control. Yet no state tax is levied on the people and property at large to provide good roads thruout the state. The only existing provision of this kind is the automobile tax, which is estimated in the office of the secretary of state to raise for the year 1914 about $400,000. Aside from this fund the state itself contributes nothing for the construction and upkeep of the roads of the state.

The state statistician has prepared the following statement:

Number miles gravel roads Jan. 1, 1914	26,364
Number miles unimproved roads Jan. 1, 1914	36,461
Number miles gravel road constructed 1913	1,740
Gravel road repairs 1913	$ 2,017,205.37
Bridges and bridge repairs 1913	2,001,129.32
Road tax worked out June settlement 1913	855,469.10
Township gravel road bonds outstanding:	
January 1, 1910	$17,089,476.37
January 1, 1911	20,501,175.44
January 1, 1912	23,441,332.37
January 1, 1913	27,489,262.26
January 1, 1914	30,950,587.94

The statistics are not complete for 1913, but those for 1912 show that the taxpayers paid out for roads in one form or another in 1912, as follows:

Gravel road bonds and interest	$3,876,881.43
Paid for new roads	5,611,403.28
Expended on bridges and bridge repairs	1,429,918.33
Expended on gravel road repairs	1,802,925.33
Paid viewers	33,326.98
	$12,754,455.35
Amount expended by townships:	
Road tax worked out	1,832,407.58
Road tax paid in cash	445,365.46
	$15,032,228.39

There are 1,017 townships in the state, and under the present system the officers and people in each township improve or do not improve the public roads there is they may determine for themselves. Each township has power to improve the public roads therein, with such material and in such way, as such township may determine. They may use any material and mode of improvement they elect, without much regard to the kind of material or improvement, if any, made in the adjoining townships, even on the main roads crossing the township. In short, the present law provides for a sort of miscellaneous patchwork system both in the kind and in the extent of the improvement. For example: If there is a main traveled road between two or more counties or cities crossing several townships in its course some parts of the road may be made of gravel, some of stone, some of cement or brick and the like, and other parts not even improved at all. It cannot be otherwise until there is some general state system provided requiring more unity and concord of action along the line of that road. Indeed a township may improve its by-roads, and leave the main roads as they happen to be, whether good or bad.

Again, as to the cost. The people of a township are not able to pay all cash down for any important improvement made on a road, and so provision is made to the effect that non-taxable road bonds may be issued in annual series running for ten or twenty years, bearing interest at 4½ per cent. per annum. While these bonds are issued by the County Commissioners they are, in law, only a charge upon the property of the township. It will be seen from the above statement of the Statistician that these bonds are increasing rapidly from year to year. The interest charge on these bonds alone is nearly $1,500,000 annually, to which must be added the yearly maturing bonds.

Thus the permanent roads within the state are under no uniform system, but each township on its own initiative makes such improvements of such roads as the people and officers thereof from time to time determine. Moreover, probably one-third of the entire population of the state live in the cities and towns who, generally speaking, contribute little or nothing to the construction of the general highways of the state.

Now as to the repairs. The duty of repairing the improved roads is by our laws laid upon the counties, each to keep up the roads within its jurisdiction. The county authorities annually levy a road tax, which is used in the up-keep of the roads and maintenance and repair of bridges. This tax is paid in cash. The work is now done under the supervision of the county highway superintendents and their assistants. The townships levy a tax for the maintenance of the unimproved roads in the townships, payable in cash and labor.

The Act of March 15, 1913, authorizes a township road tax of not more than thirty cents on the hundred dollars to be levied on all property in a township outside of the corporate cities and towns. To this may be added a levy of ten cents more on the hundred dollars for the construction and repair of bridges and culverts and for other road purposes.

It is estimated, in round numbers, that 5,000 persons in all have to do officially in various ways with the administration of the system of building and maintaining the public highways thruout the state. There is no requirement of knowledge or competency for the discharge of these duties. There is no unity in method or organization, or state regulation or supervision, direction or control. Little or nothing is being done for the safety of the traveling public at railroad crossings, where accidents of maiming and death are occurring daily.

A new power is coming into general use upon the public highways which will rapidly increase in the future. The ordinary gravel road is found insufficient to resist the stress and force of automobiles, trucks and the like; and so a new problem is presented.

Can a better and more uniform and business method be had for constructing and maintaining our public roads, commensurate with the present and future growth and needs of the state? The answer must be found, if at all, in patient and careful investigation in the light of the experience of the people of this state and other states and countries.

It is the purpose of this commission to take up the problem and return to the Governor such answer as the facts may finally determine. And in this investigation the commission solicits the help and counsel of the people and the press thruout the state.

After the address many valuable suggestions were made by the members.

It was decided to hold, during the month of September, a public hearing in each Congressional District, meetings to be determined later. The county commissioners, highway superintendents and township trustees will be asked to make reports to the commission and to these meetings, of the conditions in their respective counties.

Demarcus C. Brown, State Librarian, will collect information relative to the work from the federal government and various states.

There were present of the Highway Commission: President A. C. Harris, Thomas Taggart, W. H. O'Brien and

Leonard B. Clore, and Luke W. Duffey, Secretary. Prof. R. L. Sackett, also a member, was not able to be present. Members present of the Advisory Committee of fifteen, appointed one from each Congressional District, were: William Jones, Fairmount; Maurice Douglas, Flatrock; Lewis Taylor, Newburg; D. F. Maish, Frankfort; J. G. Short, Hillsboro; Mike Duffey, Fowler; Albert P. Fenn, Tell City; Senator George V. Kell, Ft. Wayne; Oliver Kline, Huntington; William F. Franklin, Danville; I. Newt. Brown, Franklin; C. A. Kenyon, Indianapolis; John R. Retherford, Muncie; Aaron Jones, South Bend; and Prof. E. R. Cumings, Bloomington.

The Passing of the Road Boss

Being an interview with Old Man Winters. By John N. Edy.

"No, Sir-ree, I'm not the 'Road Boss.' I'm a taxpayer and a property owner, and I live on this road. But I'm a farmer and not a road-builder; and if you've got any kicks to register, just hunt up the road superintendent and tell him your troubles."

"Old Man" Winters was about to throw in the clutch and drive on, when I detained him with my explanation.

"But, Mr. Winters, I have no kicks to register. On the other hand, I wanted to congratulate the road supervisor upon this beautiful piece of roadway. Although you do not recognize me, I remember you as the most prominent road boss of fifteen years ago. My name is Frank Edwards. Father used to say that you were the best road man in the county."

The old gentleman took a good look at me, and then sat back in the seat of his runabout and laughed. I hadn't seen anything particularly laughable, and was naturally quite relieved when he grasped me by the hand and said kindly:

"Well, Frank Edwards, I've wanted to get hold of you ever since you and that devilish brother of yours threw a dead cat in my cistern. Let's see, that was nearly sixteen years ago, wasn't it? And you remember me as the road boss? Well, well. You surely have been out of touch with this country. Don't you know that we have good roads now? Did we used to have them? No? Then you ought to know that we have adopted more business-like methods of handling our highway affairs, But, then, you've been gone a long time."

"Fifteen years is a long time, Mr. Winters," I replied as I stepped into the car and sat down beside him. I had been out for a hike over the country roads, and this invitation to ride was thoroly acceptable to me.

We were bowling along at a lively clip, skimming over the smooth surface of the country road; up and down hills that I failed to recognize because of the easiness of ascent. The bridges and culverts we crossed seemed out of place, as my memory took me back to the old wood structures spanning unsightly streams. Not only did the road and bridge improvements appeal to me, but on every hand there were indications of progress and development. The farms looked different—they looked good. Tumble-down rails had given way to the neat, uniform lines of substantial fences. The road ditches were free from debris of every kind, beautiful shade trees stood in artistic relief against the sky. In all of these surroundings I could see no resemblance to the roadside conditions that I had known as a boy.

"You see, Frank, when your father and I were neighbors we didn't have any roads to speak of. We had to look after our farms as best we could, and get to town as best we could over roads that we had to 'work' between times. Working the roads kept us in the hole most of the time.

"I was the road boss for a long time, and I tried hard to keep the mudholes filled and the old bridge floors patched. When we could haul a thousand pounds we thought the roads were in fine shape. We thought that because we didn't know what a real good road was. I didn't know what 'macadam' meant, and my way of fixing mudholes was to dump about twenty-five loads of rock in the hole and then wait for it to dry out so I could move the rocks out of the way. I used to wonder why the next rain always showed two mudholes instead of the one I started with."

"I know, too, that we moved a lot of dirt that we shouldn't have moved. You remember that we worked the roads with the big grader. That was the only machine or tool we knew. I've ruined several horses in my road building days, just because I didn't know how to operate the grader properly. And of course we didn't know anything about the road drag or of the cheap means of maintaining roads. In fact, there was no maintenance; it was all construction and reconstruction and destruction.

"Now, then, what made all this change that you see? Don't think that I did it, or that Bill Perkins did it. We helped, that's true, but I don't take any credit for that. We were at the end of our string and about down and out. The whole neighborhood was ready to quit. I was just about to follow your father out West, when the thing happened. The thing came in the shape of a Government bulletin on road building. I didn't get any other mail that day, and on the way home from town I read that pamphlet through from cover to

cover. What's that? Rural delivery? Well, I should say not. We never had rural delivery to amount to anything till we got good roads.

"Now there was something in that bulletin that made me think. The man who wrote it said a lot about road-building being a business. He said it took engineering brains to build good roads and bridges, and that a farmer could make more money as a farmer than he could as a road-builder. Then there was something about the readiness of the Government to co-operate with communities in planning their highway system.

"You can well see that here was interesting news for me. I had never looked on road-building as a business; and I had never stopped to consider how much more money I might make as a farmer if I had all my time and energy to devote to it. As for the reference to a highway system, I just couldn't figure it. But, anyway, the next day I saw Bill Perkins, and we read the bulletin together; and after we'd talked it over, we decided to put it up to the county commissioners. Of course the commissioners didn't give us much encouragement; they said we'd better call a meeting of the taxpayers, and if everybody wanted it, they'd get a Government man to come and look the proposition over.

"Let me tell you, it was some job to get the men to go in for the idea. I don't believe we would ever have succeeded if it it hadn't been for the women. Some of them got together after church one Sunday and decided that they wanted the Government road man. They said they wanted better roads so the children could get to school every day; they wanted to be able to get to town to shop, to hear lectures, and to enjoy other privileges that were withheld because of poor roads. The women wanted a lot of things that we men had never thought of; in fact, we hadn't considered our wives and children at all.

Mr. Winters stopped and looked at his watch.

"Shall I have Roy drive us in now, or will you reconsider and stay the night with us?"

"Thank you, but I must be in town before six o'clock," I told him; "but have you finished your story?"

"Why, yes," he answered. "I've told about all there is to tell. Of course the Government road man came and looked over the whole county. He stayed about three weeks making maps, plans and estimates, and gathering samples of rock, gravel, clay, etc., to send to Washington to be tested. He said he thought he could work out a system of roads that would be beneficial to us, and he did. Before he went away we had begun to realize just how little we knew about the business of road-building. He filed his plans and report, and told us how we might get the roads we wanted. And the first thing he recommended was the engagement of a road superintendent.

"We adopted the report, and hired a competent road-builder to carry out the plans. Before long we heard from Washington regarding the tests of our road material; would you believe it—we found that our deposits of road-making materials were the most valuable in the state, and worth millions of dollars to us. The Gov. ernment man had showed us a law that permitted us to issue bonds for the construction of roads and bridges, so it wasn't long before we began to see our way out of the difficulty. Built our good roads on borrowed money, that's what we did, besides that, some of us put our teams on the road and got back more than enough to meet the first assessment. I don't believe any one of us has missed the money that paid for these improvements.

"When the main roads were finished we fellows were out of a job, so I went back to farming. And not having anything else to do, I thought a lot about intensive farming. The result was that I put in a big patch of garden that netted me $1,500 that year. From that time on I've been a real farmer, and it's been worth while. I'm like Bill Perkins now—I can't afford to fool with the roads. And I believe every other man in this valley will say the same thing. We've got our system of roads and our organization that cares for them. We have a construction fund and a maintenance fund. The taxpayers pay the bills, of course. But after more than ten years of good roads I can prove that they haven't cost me a cent. My farm has increased in value more than enough to buy a whole mile of road. And when you consider the other advantages—educational, moral, sanitary and social—why, I wouldn't trade a year in this prosperous and contented community for a lifetime in a place that had bad roads."—*Successful Farming.*

Non-Corrosive Metal for Spraying Nozzle

In response to the inquiry on p. 33 of the July number of MUNICIPAL ENGINEERING for a metal for irrigation spraying nozzle not so corrosive as brass. Hoyt Catlin, of the Newnan Water and Light Commission, Newnan, Ga., refers to Monel metal as possessing the necessary quality, but on inquiry the More-Jones Brass and Metal Company, St. Louis, Mo., says that inasmuch as the ingredients include fully 20 per cent. of nickel, with a very high melting point, the price would be almost prohibitive for the purpose mentioned.

Municipal Notes

Competition on Plans for Neighborhood Center

Last year, in connection with its Housing Exhibition, the City Club of Chicago held a competition for plans for laying out a typical quarter-section of land in the outskirts of Chicago. Thirty-eight sets of drawings were submitted, the majority of which are now being prepared for publication by the club. The volume will be ready the coming fall.

This year the City Club will hold a competition for plans for a Neighborhood Center. The object of the competition is to bring before the public in graphic form the practical possibilities of enhancing neighborhood life in our cities by better and especially better grouped buildings and grounds for neighborhood activities. The drawings submitted in the competition will be shown as the special feature of an exhibition and a series of conferences on the subject of Neighborhood Centers, to be opened at the City Club, Tuesday, February 9, 1915. The club also reserves the right to publish in pamphlet or book form all drawings and theses submitted.

One of the past presidents of the City Club has offered $600 for the purposes of the competition and this amount will be awarded by a jury.

The drawings in the preliminary competition are to be delivered at the office of the City Club, 315 Plymouth Court, Chicago, at or before noon of Monday, November 9, 1914, addressed "Neighborhood Center Competition." These drawings will not be made public until the close of the final competition.

As soon as practicable after the close of the preliminary competition a jury of five members, to be chosen by a joint committee of the Illinois Chapter of the American Institute of Architects and of the City Club, will select from the plans submitted not less than eight or more than sixteen which they deem to be the best. The noms de plume of the authors of the winning plans will then be publicly posted in the main lobby of the City Club, and a list of such noms de plume will be mailed to all persons who have registered in the competition. The authors of the plans thus selected shall be eligible to participate in the final competition and should proceed without further notification with the drawings therefor.

The drawings in the final competition are to be delivered at the office of the City Club, 315 Plymouth Court, Chicago, at or before noon of Monday, January 25, 1915, addressed "Neighborhood Center Competition."

As soon as practicable after the close of the final competition, the jury will award first, second and third honors to the three sets of drawings which they deem the best among those submitted in the competition. The jury may award honors to more than three if in their judgment special circumstances demand such action. The jury will also select the eight sets of drawings which they deem the best among those submitted in the competition, and the sum of $600 will be divided equally among the authors of those eight, to cover in part the expense of preparing the drawings. A set of drawings as specified in this and the preceding paragraph will comprise a plan submitted in the preliminary competition and the drawings submitted by the same author or authors in the final competition. All drawings shall be the property of the authors, subject to the club's right of possession for publication in book form.

Inquiries for further information should be addressed in writing to "Neighborhood Center Competition," City Club, 315 Plymouth Court, Chicago. The answers will be in writing and will be forwarded, with the questions, to all competitors.

Water Filtration for Little Falls, N. Y.

City Engineer O. J. Dempster, of Little Falls, N. Y., in his annual report again calls attention to the need of a filter for the water supply, which will remove the

objectionable sediment, and safeguard against possible pollution. Owing to the then apparently large cost, the lands around Spruce reservoir were not entirely purchased when the city acquired that source of supply, and now many cottages have been erected. It is impossible to adequately guard against all sources of pollution, as a chance trespasser might cause an epidemic as those at New Haven, Conn., in 1900, in Ithaca, N. Y., in 1903.

The filter bed on Spruce is useless and the coke bed at the distribution reservoir has little sanitary efficiency, if any, as it is but a roughing filter and will remove but the very coarse sediment, and then only when the reservoir is nearly full so that the filter can be washed. The method of washing is inadequate and inefficient.

In June the distribution reservoir was gradually drawn down to a low level. There were high winds at the time so that the sides of the reservoir were washed and a large amount of sediment was carried into the coke bed, clogging it, and then being carried into the distribution system, as the filter cannot be washed when the surface of the reservoir is more than 2 feet below the spillway. If the coke had been new before the time of low water the results would have been the same.

The science of water purification has been studied but a comparatively few years and might still be considered to be in the experimental stage. However, rapid progress has been made and excellent results have been obtained in the last ten years, and it is safe to say that a filter could be designed which would give absolute protection from objectionable sediment and possible tho not probable, pollution.

Sewer Construction in Des Moines, Iowa

The original sewer plan for the city of Des Moines, Iowa, begun in 1879, contemplated a system of combined sewers with outlets to the Des Moines river at or near the Raccoon Forks. This design was followed out completely in the downtown portions but in the late years it has been found more satisfactory to dispose of storm water directly into the rivers or tributary creeks in the upper part of the city, and carry only sanitary sewage to the lower outlets. However, 128 miles of the total length of 137 miles may be regarded as combined sewers. The remaining 9 miles, which consist of strictly sanitary sewers, have been built on outlying slopes where the topography does not permit gravity outlets into existing sewers. Two small systems in the west end of the city, put into operation during the past year, are served by automatic electric pumps which elevate the sewage sufficiently to permit the discharge into existing sewers. These systems have a total length of 3½ miles and serve about ⅜ of one square mile of territory. Two other sanitary systems also in the west end, which have been operating five or six years, are taken care of by septic tanks and filters, and thence discharge into small creeks. These systems have a length of 5½ miles and serve about ½ of one square mile of territory. The total area served by existing sewers is about 9 square miles.

CONCRETE SEWER, *Des Moines, Iowa, 3 feet wide by 3.5 feet high; trench 20 feet deep, 4 feet wide.*

Large additions to the present system are now contemplated. In the east end of the city the seventh ward sewer system is already under contract. This is a sanitary system comprising about 20 miles of sewers, which will serve an area of about 2½ square miles. The outlet of this system is at the Des Moines river near the southeast corner of the city, and farther down stream than any present outlet.

In the west part of the city preliminary surveys have been made for two large sanitary intercepters, one northwest and the other southwest. These sewers will provide service for an area of about 4½ square miles and are expected to allow for several years' expansion in these directions. Outlets at both of the present septic tanks will be diverted to these intercepters thus doing away with maintenance charges at the disposal plants. Both intercepters are to be carried down to

points close to present sewers, where pumps will be placed and the sewage elevated so it can flow by gravity to the regular outlets.

The remaining step will then be the construction of a large main intercepter down stream along the Des Moines river to East Thirtieth street which will also be the outlet of the seventh ward system, and the construction there of a complete disposal plant to serve the entire city.

The photographs show the Woodland avenue sewer system under construction the extent of which is shown by the following statement of lengths and sizes:

2,328 feet of 3 feet by 3½ feet reinforced concrete.
330 feet of 2 feet by 3 feet reinforced concrete.
957 feet of 24-inch pipe.
2,017 feet of 20-inch pipe.
977 feet of 18-inch pipe.
2,466 feet of 15-inch pipe.
1,521 feet of 12-inch pipe.
6,469 feet of 10-inch pipe.

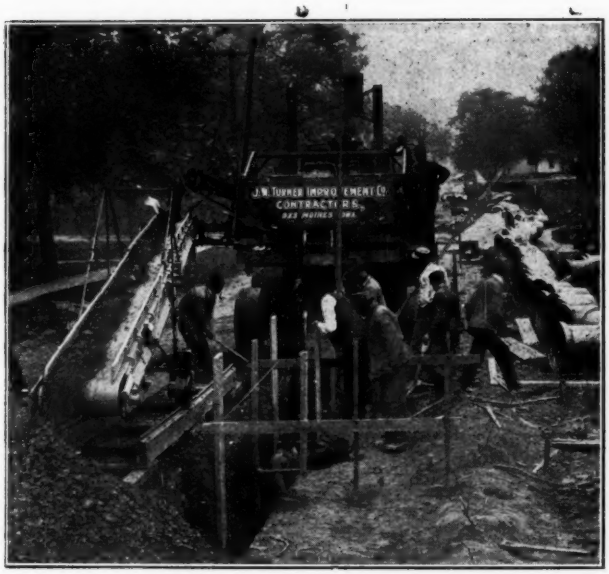
17,065 feet total.

The concrete sewers were built of a mixture of one part cement to five parts of unscreened gravel. The larger sewer was reinforced with ⅝-inch square section deformed bars placed 6-inch centers on the roof and 18-inch centers on the side walls, with ½-inch longitudinal bars spaced 12-inch centers. The reinforcement of the smaller section was the same as of the larger, excepting that ½-inch bars were used in place of ⅝-inch bars.

A sub-drain was placed under the entire length of the concrete sewer, so that all ground water was drawn away before placing the concrete.

The J. W. Turner Company has built about 20 miles of sewer in the same section of the city of the same nature, tho not of the same depth. The trench machine shown in the photograph cuts a trench anywhere from 28 to 60 inches in width, and up to 20 feet in depth. A larger machine cuts 6½ feet wide.

In laying pipe sewers the company usually operates with about fifteen men, and, with the back-filler in use as shown in the photograph of the pipe sewer, one team is sufficient to keep the machine supplied with water and haul lumber and tools ahead of the work from time to time. When not using the back-filler it requires from three to four additional teams to replace the earth in the trench.



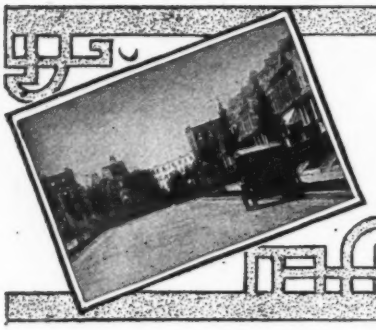
LAYING PIPE SEWER *in Des Moines, Iowa, with trench machine and conveyor for back-filling.*

When building concrete sewers additional men are required to mix and place concrete, and to place and remove forms. The workmen prefer machine work to hand work, and where working a machine a full gang is usually sure, whereas, on work to be performed entirely by labor, the contractor can never feel sure of sufficient men.

Denatured Electricity

An interesting method of preventing the improper use of electric current has been devised by an Italian engineer. The practice of making especially low rates for current to be used in electric power, heating and cooking devices is becoming more and more general, but with the ordinary constant potential current it is difficult to detect the use of lighting devices on circuits intended only for power and heating purposes.

This engineer advocates the use of special circuits on which the current is subject to extreme fluctuation of voltage at rapidly recurring intervals, which would make it practically impossible to use lamps, because of the flicker in the lights. As the current is not entirely interrupted and the normal voltage is almost immediately restored, the proper operation of power or heating apparatus is not interfered with and the rightful use of the circuits for their respective purposes is assured.



MISCELLANEOUS

Geology for Engineers

The professors of economic geology in Cornell University and the University of Virginia, Drs. Heinrich Ries and Thomas L. Watson, have put into book form the work given to the students in their subject in a new book entitled "Engineering Geology" ($4). Both have been connected with state geological departments and as such have become conversant with the economic side of geology, which Professor Ries has considered in some detail in earlier books and reports devoted to certain classes of industries.

The present book is broader in its scope, covering as it does the rock-forming minerals, the general characters and origins, structural features and metamorphism of rocks, rock-weathering and soils, surface and underground waters, landslides, wave and current action, lakes, glacial deposits; and the uses made of various materials resulting from the causes and combinations previously described, such as building stone, lime, cement, plaster, clay and clay products, coal, petroleum, natural gas, asphalt, bitumen, ores, and road foundations and materials.

The book is fully illustrated, and, while apparently built primarily as a text-book, will be useful to the general and particular seekers for information.

Prizes for Highway Study

Awards have been made in the competition announced several months ago by the Barber Asphalt Paving Company, for papers from engineering students on the subject of Asphaltic Materials for Highway Construction. The judges of the competition, E. J. Mehren, editor Engineering Record, and H. P. Gillette, editor Engineering and Contracting, have made awards of prizes of $100 each to the following contestants:

Frederic O. X. McLoughlin, New York City, Columbia University.

Harry Schindler, Brooklyn, N. Y., Cornell University.

B. J. Fletcher, Parrott, Ga., University of Georgia.

John W. Hill, Chicago, Ill., University of Illinois.

Robert S. Johnson, Ireton, Ia., Iowa State College.

M. V. Holmes, Kansas City, Kans., University of Kansas.

F. P. Gilbert, Beverly, Mass., Massachusetts "Tech."

Harold J. LaLonde, Sault Ste. Marie, Mich., University of Michigan.

Benjamin Wilk, Virginia, Minn., University of Minnesota.

Alvin C. Smith, Lyons, Neb., University of Nebraska.

O. H. Gosswein, St. Louis, Mo., Purdue University.

Alfred A. Berkowitz, New Britain, Conn., Sheffield Scientific School.

W. J. Campbell, Cohoes, N. Y., Syracuse University.

The purpose of the competition was to turn the attention of engineering students to street and road construction as a promising field of work. The company offering the prizes believes that the plan was successful in this direction.

Personal Notes

At the celebration of the fiftieth anniversary of the founding of the School of Mines of Columbia University, the trustees conferred upon Mr. Gano Dunn, president of The J. G. White Engineering Corporation, the honorary degree of Master of Science in recognition of accomplishments and distinction in science and electrical engineering. Mr. Dunn is president of the United Engineering Society and has been president of the American Institute of Electrical Engineers and the New York Electrical Society. He is a member of the British Institution of Electrical Engineers, the International Electrotechnical Commission, American Society of Mechanical Engineers and other scientific and engineering bodies and was United States delegate to and vice president of the last International Elec-

trotechnical Congress which was held in Turin, Italy, in 1912.

John H. Gregory, of Hering & Gregory, consulting engineers, New York, and C. E. Gregory, chief engineer of sewers, Boro of Manhattan, New York, will sail for Europe on July 4th where they will spend the summer studying European methods of sewage and refuse disposal and some of the most recent methods of water purification.

H. L. Cory is city engineer of Baker, Mont.

W. H. Hall has been appointed city engineer of New Britain, Conn.

W. J. Fulton has been appointed city engineer of Gary, Ind.

A. T. Thompson is the new city engineer at Chippewa Falls, Wis.

J. J. Smith is city engineer of Grand Forks and East Grand Forks, N. D.

Theodore A. Leisen has resigned his position of chief engineer of the Louisville Water Company to accept the general superintendency of the water works of Detroit, Mich.

Prevost Hubbard, Assoc. Am. Soc. C. E., in charge of division of roads and pavements, The Institute of Industrial Research, Washington, and lecturer in highway engineering chemistry at Columbia University, and Arthur H. Blanchard, M. Am. Soc. C. E., consulting highway engineer, and professor in charge of the graduate course in highway engineering at Columbia University, have been elected by the council of the International Association for Testing Materials the American members of Commission No. 58 on "Standardization of Methods of Testing and Nomenclature of Road and Paving Materials."

H. A. Strauss, consulting engineer, of Chicago, has been retained by the bondholders' committee of the Alton, Jacksonville & Peoria Railway Company, to prepare a complete valuation of the company's property, to be submitted to the Illinois State Public Utilities Commission in connection with the application for authorization of re-organization of the company and the issuance of stocks and bonds thereunder. This will be the first extensive valuation of an interurban railway submitted to the Illinois commission.

Clarence D. Pollock, M. Am. Soc. C. E., with experience in charge of paving work in New York, Brooklyn, Havana, Cuba, and San Antonio, Texas, announces that he has opened offices in the Park Row Building, New York City, as consulting engineer, and will make a specialty of pavements, drainage, and other municipal problems.

Technical Associations

At a special meeting of the board of directors of the American Road Builders' Association it was unanimously voted to hold a joint meeting with the American Highway Association in 1915, either in San Francisco or in Oakland, during the Panama Pacific Exposition, the exact date to be determined later. The management of this joint meeting will be in the hands of a committee of five made up of two members from each association, the fifth member to be selected by these four.

The Federation of Trade Press Associations will meet at Congress hotel, Chicago, Ill., Sept. 24-26. E. R. Shaw, 537 S. Dearborn St., chairman of committee.

The eighth annual convention of the Illuminating Engineering Society will be held at the Hollenden hotel, Cleveland, O., Sept. 21-25.

The annual convention of the New England Water Works Association will be held Sept. 15-18 in Boston, Mass. Willard Kent, Narragansett Pier, R. I., secretary.

The International Association of Municipal Electricians will meet at Atlantic City, Sept. 20-23. C. W. Pyke, Elcetrical Bureau, Philadelphia, Pa., secretary.

The American Highway Association meets at Atlanta, Ga., Nov. 18-20. I. S. Pennypacker, executive assistant, Colorado Bldg., Washington, D. C.

The American Society of Municipal Improvements meets at the Somerset hotel, Boston, Mass., Oct 21-23. Charles Carroll Brown, secretary, Indianapolis, Ind.

The International Association of Fire Engineers meets Sept. 21-25 at the Grunewald hotel, New Orleans, La. Jas. McFall, Roanoke. Va., secretary.

Publications Received

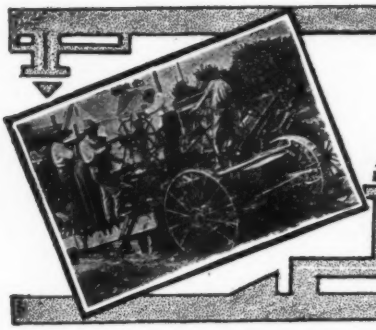
Fourteenth annual report of board of water and lighting commissioners of McKeesport, Pa., for 1913. E. C. Trax, filtration department.

Twenty-seventh annual report of the State Board of Health of Ohio for 1912. W. H. Dittoe, chief engineer.

Main drainage and sewage disposal works proposed for New York city. Reports of experts and data relating to the harbor report of the Metropolitan Sewerage Commission of New York, of April 30, 1914. Geo. A. Soper, president.

Proceedings of the National Conference on Concrete Road Building, held at Chicago, Feb. 12-14, 1914. Issued by the secretary, 208 S. LaSalle St., Chicago, Ill. Paper, 210 pp.

The Discharge of Yukon River at Eagle, Alaska Water Supply Paper, 345-F., U. S. Geological Survey.



MACHINERY AND SUPPLIES

Progress in Road Building

In publishing a new Bermudez Road Book, the Barber Asphalt Paving Company emphasizes the fact that we now have five years' service experience upon which to base judgments as to the durability of asphaltic concrete and macadam. Following out this line of argument, the illustrations are mainly confined to showing roads built in 1909 and 1910 as they look to-day. Among these are several 1909 roads that have cost practically nothing for maintenance. The New York State roads of this era, it is stated, are in much better condition than roads of later date. There are now more than 12,000,000 square yards of Bermudez roads in existence, the equivalent of 1,325 miles of 15-foot roadway. The cover of the booklet is something of a novelty, being a photographic reproduction of the surface of a penetration road, without a seal coat.

Preservative Treatment of Poles for Line Wires

The normal yearly production of poles in the United States is about 2,750,000, and today there are, approximately, over 50,000,000 poles supporting wires, either telephone, telegraph, light, or power. It is only of recent years that the pole user could be induced to take the precaution of preserving his timber.

In the last few years, prompted by their increased price, there is hardly a pole set without the owner's having some idea of preserving it. He begins to compare what he or his predecessor formerly paid for a pole with the present price, hence he begins to figure how to stop the expense of replacing rotten poles.

Since the records obtained in the past years show what ingredients remain in treated timbers the greatest period of time, it is natural to conclude that a good preservative should contain as great an amount of these ingredients as it is possible to obtain. The impregnating process, while one of the oldest methods known is yet in its infancy. The records referred to, however, are based on timbers which had been treated with a tar oil under pressure. This method if properly used is frequently so expensive that the additional cost makes its use prohibitory.

It is the high boiling oils of coal tar which preserve timber, because that is what was obtained by subjecting the preserved timbers to dry distillation. The records do not show whether or not these high boiling oils originally contained any neutral, such as paraffin or similar oils, which have not as yet been proven germicidal.

The average tar oil obtainable, which is forced into timber under pressure, contains from 15 to 35 per cent oil distilling above 300 degrees centigrade. Hence, if an oil that contained 35 per cent distilling above 300 degrees centigrade, at most, which had been injected into the timber showed such excellent results, it is reasonable to suppose that a lesser amount of oil containing proportionally a greater per cent of distillate above 300 degrees centigrade will bring good results when properly applied.

It is important for the one who supposes petroleum to be a preservative to exercise much care in the selection of the petroleum because it may prove an unwise form of economy, as it has repeatedly.

In 1900 the C-A-Wood-Preserver Company began directing attention to the value of high boiling tar oils as against the offered "secret" or "patented" processes in connection with preservatives. Since scientific investigations by the government and others have substantiated these theories and arguments, some are attempting to use preservatives which are the high boiling portions of crude petroleum. These mislead the chemist unless he make the sulphonation test. The company mentioned, in 1886, sold one of the first barrels of coal tar distillate that came to America. This product which was intended for the superficial method, distilled only 75 per cent above 300 degrees centigrade. Eleven years afterward this was increased to 85 per

cent and during the summer of 1909 to 92 per cent. This was the highest mark reached so far and it required special machinery to produce it.

It is practically impossible to produce a successful oil distilling more than 92 per cent above 300 degrees centigrade according to the United States Forest Service method of analysis, as it would solidify at normal temperature if it were free from petroleum residues or similar oils. Some tars will distill much more than 92 per cent above 300 degrees centigrade, but they are not free from the paraffin oils which have a high boiling point tho they are nongermicidal.

While it has been less than a year since a strictly coal tar distillate containing as much as 92 per cent liquid residue (oil) above 300 degrees centigrade (United States Forest Service method) has been manufactured and put on the market, it may be interesting to note a few records and illustrations of the methods of application and results derived from the use of that heretofore produced, or from the oil distilling 85 per cent above 300 degrees centigrade.

After determining the quality of preservative, the pole user is interested in the method of application. The brush method is the simplest and most universally used. Next is the pouring system, which is done in two ways. One consists of a portable tank, while the other is stationary, the poles being conveyed to the treating tank.

Poles which are already erected and which have begun to show decay can be saved by a very simple method. By digging away the earth to a depth of about two feet around the pole, applying two coats of a good preservative with a brush and then replacing the earth, the pole is saved. Rot is caused by a germ and the preservative being a germicide or antiseptic kills those present when applied to the decaying parts and its presence in the wood prevents future decay as well. The manager of the Memphis (Tenn.) Telephone Company, in 1904, made this experiment on cypress poles and he reports them in perfect condition today with every evidence of lasting many years longer. The Austin (Texas) Electric Railway Company has likewise found this a most successful experiment on cedar poles.

Cross arms can be treated by the brush method, however, the complete dipping or immersion is the more favorable. The cost of treating a pole depends upon its size, character, condition, price of the preservative and the amount used—whether it be be treated at the ground line only or the entire butt end. There is a variation from four cents to perhaps a dollar per pole and each user of poles knows best what he can afford to pay for the protection of his timber.

Last, but not the least important, it should be noted that under no circumstances should unseasoned or green timber be treated, regardless of the preservative used; it must be at least partly seasoned to allow penetration.

Universal Portland Cement Co. at the Panama-Pacific Exposition

Approximately 42,000 square feet of space in the palace of Mines and Metallurgy, at the Panama-Pacific Exposition, will be devoted to the exhibit of the United States Steel Corporation. The Universal Portland Cement Company, which is a subsidiary to the corporation, has planned an extensive display. Behind a series of concrete arches will be hung paintings illustrating the most important uses of concrete. In the center arch an actual model of a cement plant will work during the exposition.

The central feature of the exhibit will consist of an actual reproduction on a two-thirds scale of a portion of a factory building, constructed thruout of reinforced concrete. Within this space, which will be used as a reception booth, will be shown a chart describing graphically, and with samples and outline, the manufacture of cement, pictures of the various plants of the company, models of concrete structures and photographs of concrete work.

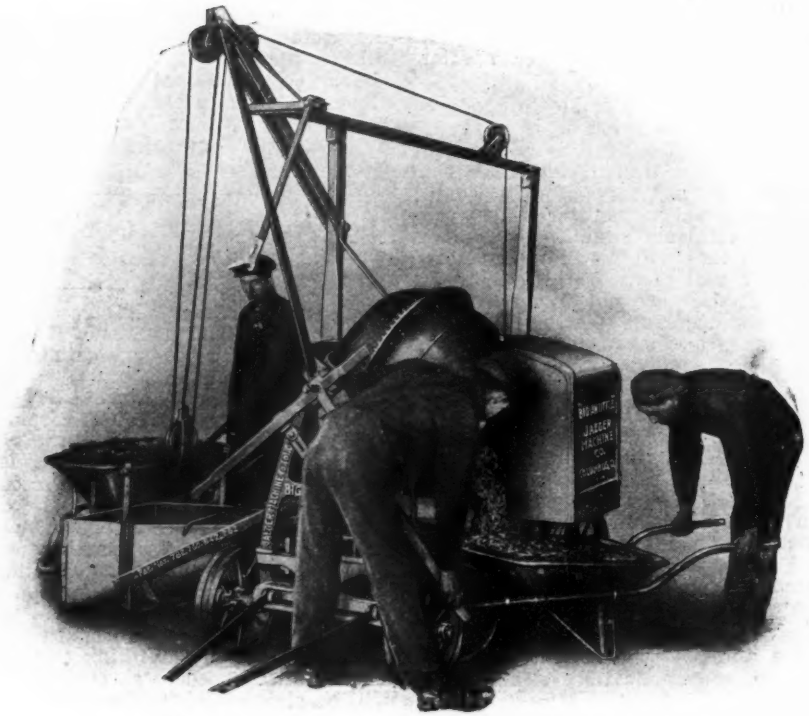
The other subsidiary companies of the corporation are planning equally elaborate displays. An important feature of each exhibit will be something illustrative of the manufacture of the product which it represents.

To one visiting the displays of the corporation will be presented an opportunity of learning the history, salient features and manufacturing processes of some of the country's largest industries.

A Mixer Designed For Concrete Sidewalk Work

In each city, town or village will be seen some newly completed sidewalk or a new job that is just going in. In many cities brick walks are being ordered torn up by the authorities and are replaced by only one kind of sidewalk—that of concrete. All new walks are of concrete and in all of the new additions and subdivisions, nothing but concrete walks are being put in, together with miles of concrete curb and gutter.

Most of the concrete mixing for this work has been done in the past by both small and large contractors on a mixing board by hand, for the reason that there was offered to them no dependable mixer



THE JAEGER *Big-an-Litle concrete mixer for sidewalk, curb and gutter work.*

for doing this particular class of work. The result of this hand-mixed concrete has been that many inferior concrete walks have been laid. In all cities where specifications have been rewritten in the past year or two, they require that the concrete be mixed in a concrete batch mixer, subject to inspection of regularly appointed city inspectors.

In following such specifications, it is necessary to operate a power mixer, and the contractors at first were at a loss to know where to obtain a mixer suitable for this particular class of work, as the large batch mixers heretofore used were not adaptable, since they cost too much, are too clumsy and too costly to operate on sidewalk work, and the depreciation of value is too great. The Jaeger Machine Company, who have been building mixers, both large and small, for all purposes for the past nine years, were among the first to see these conditions and two years ago brought out a mixer for this specific purpose; a mixer that is dependable; a mixer that costs only a reasonable sum to buy; a mixer that is economical to operate; a mixer that was not an experiment, but the result of seven years' experience and practical development. Its low cost, light weight and durability, together with the capacity of at least 1,500 square feet of walk per day, including the top coat, were just what the contractors were looking for, and consequently hundreds of them are used for sidewalk work. Dozens of them have been sold to municipalities who put in their own sidewalks, curbs and gutters, as well as to other municipal departments, such as waterworks, fire departments, electric works and others. Hundreds are in use by all sorts of contractors on public work, as well as private contractors, and they enjoy a hearty recommendation by inspectors and engineers.

It is not necessary to purchase a large mixer in order to have a really dependable one, as the "Big-and-Little" mixer is a real mixer in every way, with great strength and durability, and operated at the lowest possible expense. Furthermore, this mixer is sold on a one-price basis to all, and a low one that will enable the big contractor to purchase many of them and the small contractor to purchase one, instead of using an old-time mixing board.

These mixers are working everywhere. Stop and inspect the next one seen and write for full particulars. Get in touch with the manufacturers, the Jaeger Machine Company, Columbus, O.

PLACING REINFORCEMENT *in concrete street pavement. Note ease with which two men unroll and lay the sheet of reinforcing metal.*

Reinforced Concrete Street Paving

The use of a sheet of reinforcing metal in concrete pavements is becoming more popular as its action in preventing the spread of cracks in the concrete from temperature changes, frost or flood damage is understood. Highland Park, Mich., of which W. H. Beckley is engineer, has used this construction as shown in the accompanying photographs.

The specifications provide for a 5-inch concrete base of proportions 1 cement, 2½ sand and 5 crushed hard rock, and a wearing surface of 1 cement, 1 sand and 2 hard rock or granite screenings.

As shown in the first photographs, the sheet of reinforcing metal is laid on the surface of the base, in which it is embedded as shown in the second photograph. And the wearing surface is then laid and formed by a template as shown in the same view.

Meyer and Labadie, the contractors on the street chose No. 8 rib metal of the Trussed Concrete Steel Company from among the materials admitted by the specifications "feeling that the greater ease of installation and the very superior reinforcement provided in rib metal justified paying the difference in the original cost price." They estimate the cost of laying rib metal at not more than one cent a square yard, practically the whole expense being the hauling of the material from the cars to the job, since the sheets are shipped from the shop ready to lay in the pavement. The ease of placing is seen from the photographs, also the facts that no pegging or stretching is neces-

REINFORCING METAL *in place in concrete pavement on lower layer; workmen are placing the wearing surface over both.*

sary and that there are no kinks to straighten out.

The third photograph shows the method of placing armor plates for expansion joints at the street intersections. Two plates with sheets of elastic paving joint material between form each joint. The anchors to bind the armor plates to the concrete are seen in the photograph, which shows also the arching of the plates to fit the crown of the street and the pegging into place, the pegs being removed as the concrete is placed.

It will be noted that the joints form a rectangle with sides about on the lines of the curb of the two streets. From each corner of this rectangle a short joint of the same kind runs over to the curb, since the rounding of the curb corners leaves a distance of some feet between the circle of the curb and the intersection of the general lines of the curbs. This makes one block of the center of the street intersection and one block of each wing of the intersection of the side street, leaving the regular blocking by expansion joints of the street under construction undisturbed.

The street intersections are troublesome places to take care of in brick, wood, concrete or like expansible materials, because the change in crown caused by the entrance of the intersecting street introduces a change in the direction of resistance to the temperature stresses and thus makes it possible for expansion of the surface of the pavement to cause the elevation of that surface at the weakest point, which is likely to be at the center of the intersecting street. This is shown in the picture of the explosion of a brick street at a street intersection, printed in the July number of MUNICIPAL ENGINEERING.

Making a single slab of the street intersection and protecting it with expansion joints on all four sides reduces the danger of trouble very materially, especially if the reinforcing metal sheet is used to take the tensile strains arising from the tendency of the intersection slab to buckle.

These armor plates for expansion joints are made by the Trussed Concrete Steel Co., of Youngstown, O.

PLACING *Trus-Con expansion joints at a street intersection. Note the rectangular block thus formed in the intersection and the short joint from the corner of that block to the rounded curb corner.*

Ingenious Water Cooling System

During the summer months especially, the problem of securing suitable drinking water is one that faces every factory manager.

That temperature is an important consideration is shown by the interesting experiments of Dr. Thomas Darlington, secretary of the Welfare Committee of the American Iron and Steel Institute. He found that the range of temperature at which water is palatable is extremely limited. Water is most enjoyable when at 50 to 55 degrees Fahr. At this temperature it has a stimulating action on the heart, and relieves fatigue and exhaustion, by equalizing the temperature of the body.

Water which is warm is insipid and uninviting. Water which is very cold, it is well known, is liable to cause violent illness, such as cramps, prostration, etc. Absences and inefficiency, particularly during the summer, have been definitely traced in many cases to the lack of a proper drinking water supply.

A unique system for properly cooling and distributing drinking water, known as the J-M system, is now being extensively adopted by many manufacturing concerns of national prominence.

The water is cooled to the right temperature by the A-S refrigerating machine and is then piped to bubbler fountains placed at advantageous locations thruout the plant.

The A-S refrigerating machine is entirely different from any other. The refrigerating vapor is sulphur dioxide. The very offensive and corrosive gases usually used are done away with. The working mechanism is entirely enclosed and sealed. Practically no attention is necessary as the machine operates for years without refilling, adjustments or repairs.

To run this machine it is merely necessary to throw on a switch. To stop it, pull the switch. A thermostat connection is arranged to start and stop the machine at certain temperature limits, thus automatically keeping the water at a uniform temperature all the time.

The bubbler fountains used with J-M systems are carefully designed to permit the flow of an ample, satisfying stream without waste.

This system, besides having the distinct advantage of providing a proper water supply, eliminates the disadvantages connected with the use of ice. It makes the plant manager independent of uncertainties in the ice supply. It does away with the disease-spreading possibilities of the common cup and polluted ice. It discourages the habit of congregating around the drinking place and wasting time. In many cases, it is said, the J-M system shows an actual economy over the ice-cooled method.

An interesting booklet describing this system in detail has been issued by the H. W. Johns-Manville Co., N. Y.

Motor Omnibuses in Boro of Queens, New York

The Hillside Transportation Company having asked for a franchise to operate motor omnibuses on five routes aggregating about 18 miles in the Boro of Queens, New York City, the Board of Estimate and Appointment has passed a resolution permitting the operation of a part of the routes for an indefinite period of time, not exceeding one year, so that data can be obtained on which to base terms for a franchise, there being nothing available at present on which to formulate such a franchise. The company is to pay 5 per cent. of the gross receipts from the operation of the lines, not less than $15 per month per mile of line operated. This payment seems to be considered as payment for damage to streets, cost to city on account of the operations of the company, and the like. No maximum rate of fare is proposed, but it is understood that it is the intention to charge 10 cents for the full length of line and 5 cents for short rides between. The question of fares is one on which there is not enough information and a year's operation will give some.

The lines do not compete with existing street car lines and in that respect are in better condition than the lines in Indianapolis which were obliged to reduce their fares from 10 cents to 21 tickets for $1, and later to 5 cent fare with 25 tickets for $1, the same as the street cars. It is understood that at these latter rates the company was able to pay operating expenses but could not make proper provision for replacement of stages as they wore out, so that it was obliged to quit business.

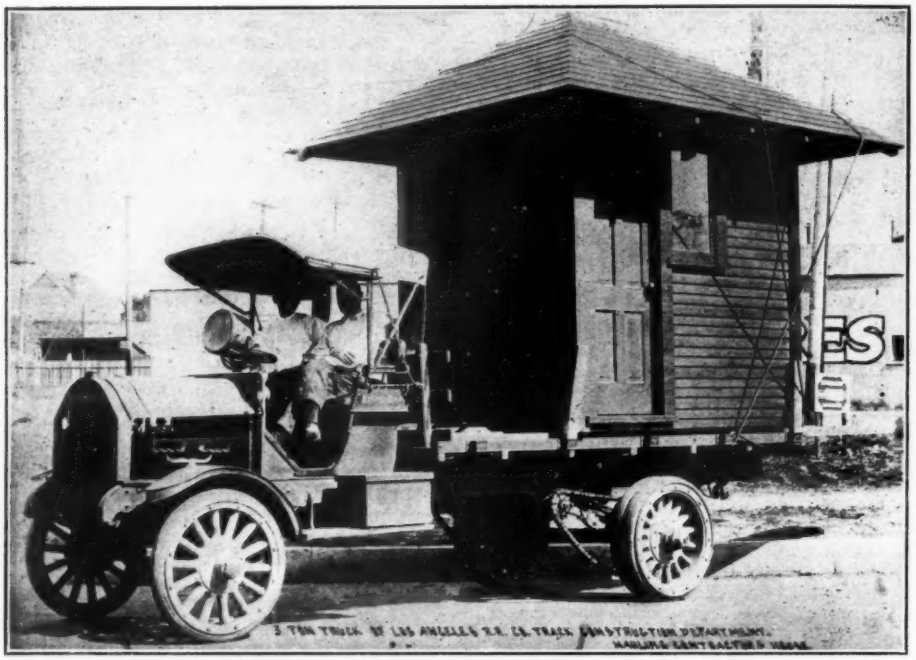
The New York company will begin business with four stages, to be increased to six, and the success of the operation as well as the effect on the streets and roads will be awaited with interest.

London motor omnibuses are reported to be very severe upon the streets over which they run.

Trade Publications

The Marsh-Capron Mfg. Co., Old Colony Bldg., Chicago, Ill., has issued catalog No. 30 regarding M-C rail-track mixers for concrete, whose motto is "Most Mixing, Least Fixing." The mixer is also used in plants manufacturing glass and fertilizers and in zinc works and foundries.

The Harris Patents Co., New York, is-



sues a series of circulars on the Harris valveless Diesel engine, entitled "From Stone Cold to Full Power in Ten Seconds."

The St. Louis Distributer of oil and tar over roads and pavements is illustrated in a circular issued under the above title from 612 National Bank Bldg., by J. C. Travilla, W. L. Hempelmann, and O. S. Brighton.

The Kissel-Kar in Contractors' Work

The accompanying photograph shows a three-ton Kissel truck operated by the track construction department of the Los Angeles Railroad Company hauling a contractors office building, indicating the varied uses to which it can be put. Note the method of holding the building in place on the truck by means of ropes and stakes.

The Seebee Dryer

The illustration on page 170 of the Seebee dryer is of interest to every up-to-date asphalt paving man. The unique feature of the Seebee dryer is "Two Dryers in One."

The flue-jacketed inner drying cylinder and the hollow cascading blades shown in cut double the heating and drying capacity without shortening the life of the dryer by forcing it.

When the material is fed into the Seebee dryer it is immediately distributed over a large area of heating surface, part of the material going into the inner drying cylinder and the other part going into the outer dryer cylinder, so that the material flows and cascades around the heated inside surface of the outer dryer cylinder as well as around both the heated inside and outside surfaces of the inner drying cylinder. So, by adding the inner cylinder the material comes into contact with greately increased area of heating surface over what could be obtained without the inner cylinder and the moisture in the material is quickly vaporized in consequence.

Then as the material travels through the rear portion of the cylinder it is divided into separate masses by the perforated diaphragm plates which divide the cylinder into longitudinal compartments. The hot air from the furnace is drawn thru the hollow lifting blades and thru the masses of material rolling and cascading over the blades, then the hot air ascends thru the perforations in the diaphragm plates thru the material which is being cascaded across the diaphragm plates, so as to ensure a perfect commingling of the heated air with the material as it travels thru the cylinder.

The inventor of the Seebee dryer, Mr. C. B. Smith of Cleveland, Ohio, has had many years' experience designing and building dryers and asphalt paving plants. His firm address is C. B. Smith & Co., 411-412 Prospect-Hippodrome Bldg., Cleveland, Ohio.